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An Ancient Mechanician and His Cabinet of Mechanical Curiosities.

BY W. F. DURFEE.

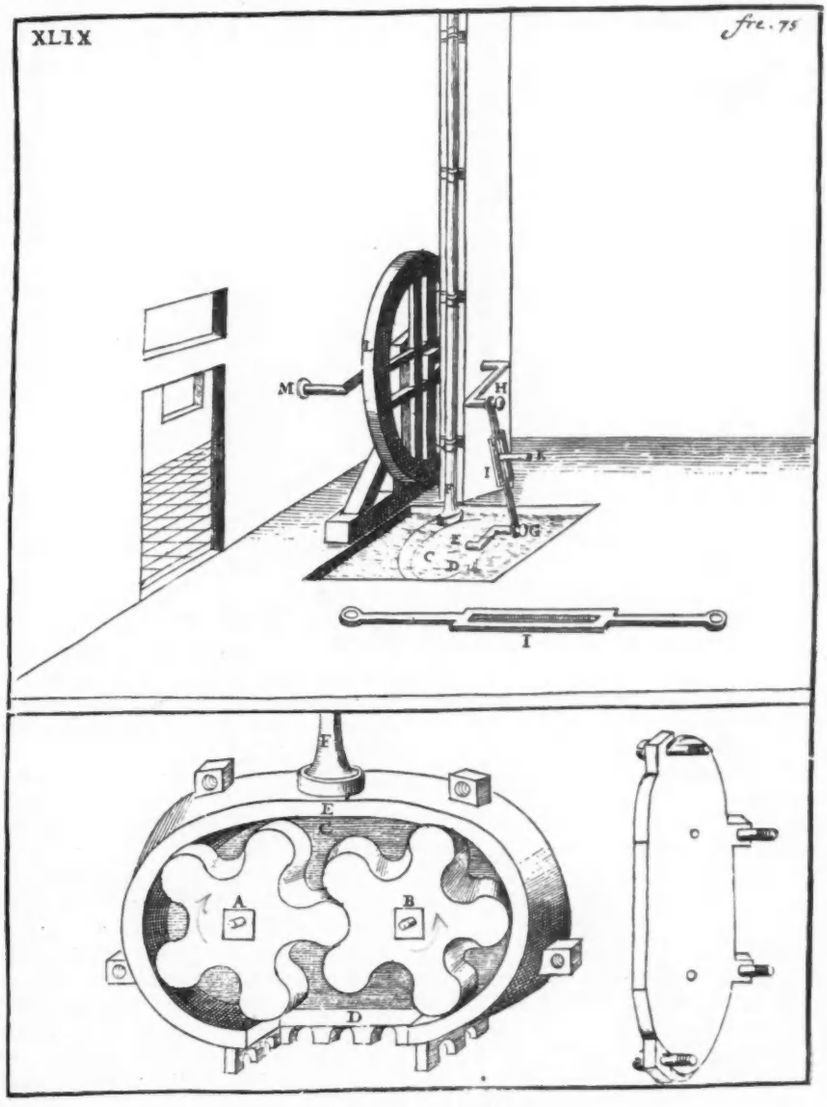
In the year 1596 there was born at Lyons, France, one of the most ingenious mechanicians who ever lived, Nicholas Grollier de Serviere. He was descended from a long line of illustrious ancestors, and at the age of fourteen was sent to the army in Italy, where he rapidly distinguished himself, and at the siege of Verceie (in 1630) he lost an eye.

From his entrance upon a military career until he retired, after having attained the rank of Lieutenant-Colonel, his life was spent in marches, battles and sieges, in which last he often acted as Chief of the Engineers, and if his modesty had not been greater than his merit, he would have ranked in history among the foremost of the great commanders of his time.

He left the army at about the age of fifty-five, and devoted the remainder of his long life to the invention and construction of the marvels of his "Cabinet." He died in 1689 at the age of ninety-three years.

The inventions and models comprised in his "Cabinet" have been admirably described and illustrated in a work ("Recueil d'ouvrages curieux de Mathematique et de Mechanique, ou Description du Cabinet de Monsieur Grollier de Serviere; Avec Planches en Toille-douce. Par M. Grollier de Serviere, son petit Fils-Ancien, Lieutenant-Colonel, etc., etc. A Lyon, 1719") published at Lyons by his grandson in 1719; a second edition of which (published in Paris), considerably enlarged, appeared in 1751. The first edition is illustrated by 88 copper-plates, 6 x 8 inches, and the second edition has 95 plates of the same kind. This work is divided into three parts. The first treats of Turning, and embraces a large variety of objects in ivory, many of which are exceedingly curious and intricate, and the production of which must have required mechanism and methods commonly supposed to have been first invented long after Serviere's time. Notable among these is an ivory vase, 9 inches high and 5 inches in diameter, of such irregular figure as could not have been executed in a lathe without the employment of a pattern vase to control the movement of the cutting tool; an idea long supposed by many writers to have originated in America a hundred years later.

The second part of this book is devoted to the description of curious clocks, seventeen in number, all of which show great fertility of invention and skill in execution. In one of these clocks the figure of a tortoise swims in a basin of water, around the edge of which the hours are engraved. This tortoise can be removed from the water and replaced at pleasure, when it will immediately swim to the proper hour and indicate it with its nose.



AN ANCIENT PUMP.

The third division of the work includes the description and illustration of a large number of models of machines for a great variety of purposes—such as grinding mills, pile drivers, military machines, floating bridges, hand-driven paddle-

wheel boats and many machines for raising water, among which are several curious pumps; from which last we select the following, which is entitled: "A very simple machine for raising water from a well or reservoir to a considerable height."

"The two gears *A* and *B* are solidly made of wood or metal, and occupy all the space in the oval case *C D*, in which, nevertheless, they must turn freely and engage with each other. The case *C D* must be strongly made, and must have no opening except at the lower part *D*, as indicated in the figure, and at the top at *E*, where there is a hole to which the large end of the pipe *F* must be connected. All the other parts of the case must be well jointed and packed. This case must be put in the well or reservoir from which you wish to raise water, and there securely fastened in such a way that it is always covered with water. To the gear *A* is attached the cranked axle *G*, which is connected to a second cranked axle *H* by the piece of iron *I*, and the cranked axle *G* is compelled to move in unison with the rotation of the axle *H*, for the reason that the piece of iron *I* is provided with a slot, as represented in the figure, and cannot move except about the fixed pin *K*, the result being that its two ends are always in every way similar in their movements. Therefore, when the crank *H*, which is a part of the axle of the great wheel *L*, happens to turn, it follows that the cranked axle *G* turns also, and consequently not only the gear *A*, but the gear *B*, revolves. When these two gears turn, the water which has found entrance between their teeth, at the part marked *D* of the oval case *C D*, is there kept until it comes to the space *C*, into which it is crowded by the continual supply of water which enters between the teeth of the two gears and is thus carried forward. Then the water, which is not able to find room in this part of the case, and cannot go out by the way it entered, is therefore forced into the pipe *F*, in which it gradually rises to the place to which it was to be elevated.

"An examination of the figure will show that we can turn by the force of the hand the great wheel *L*, and consequently its cranked axle *H*, and the gears *A* and *B* by means of the crank *M*."

Serviere may have supposed that he was the original inventor of the whole of this apparatus; but, as a matter of fact, the double-gear rotary pump was an old contrivance long before his "Cabinet" was commenced. However, he is without doubt entitled to the credit of the peculiar method of transmitting rotary motion by means of a slotted connecting rod moving under control of a fixed guiding pin. This movement has therefore been before the public for 177 years, but has been so little known that it has very rarely indeed been figured in collections of mechanical movements, or mentioned by writers on such subjects. Nevertheless, it has been patented within the last forty years.

Cost-Keeping — Some Large Air Hoists—A Right-Angle Coupling—A Rack Cutter—The Centers of Arbors.

Most engine builders are just now more interested in the subject of prices than in anything else connected with their business, and with some of them this question takes the form of how long they can probably continue in business if there is not some improvement in the matter of the margin between the cost of pig iron and forgings and the finished machines. In discussing this matter with Mr. Richter, of the Hooven, Owens & Rentschler Company, he said he thought one of the principal reasons for the demoralization in prices was due to the fact that there are so many in the business who have no definite idea what a job costs them and just slash around, bidding lower and lower to get business, imagining all the while that if they are making no money, or are losing, the other fellows are too, and that some of them will soon be crowded out of the business, when prices will be better.

It is pretty well understood among the knowing ones that buyers' stories about wonderfully low quotations are often to be taken with a grain of salt; they are very closely related to the fake telegrams and other devices employed by the Wall street bears, but they serve to still further demoralize men who do not know just what their work costs them, and think that "if Crank, Pin & Co. can build that engine for thirty-two hundred and fifty dollars we can build it for even thirty-two," when as likely as not the fact is that they cannot build it for a cent less than thirty-five without actually losing money on the job.

We all know that there is such a vast difference between different shops in the matter of equipment, management, etc., that one shop can do well at prices that will sooner or later land the proprietors of another shop in the poorhouse. It is the rankest folly for a shop to go on competing on such terms, and there is little doubt that much of such competition would disappear if strict and accurate cost accounts were the rule.

Every engine that has been built by the Hooven, Owens & Rentschler Company is represented by a book which is kept in a fireproof vault adjacent to the office. Take any one of these books and you have before you the full particulars regarding the cost of producing a certain engine, whose number, date of building, etc., fully identify it. The books are inexpensive ones, but are large enough to have inscribed in them the cost in detail of each operation upon the engine to which they relate. The total shows the man who is bidding on a job just what the last similar engine cost to build, while the detailed record of cost of this and other engines shows, either exactly, or very nearly, what the added or lessened cost will be for any proposed alterations of design or arrangement. They may at times, and for special reasons, go very close to this cost, especially when recently adopted improvements in shop methods warrant the belief that costs will be somewhat reduced; but they do not go below it, and, whatever they do, they know just what they are doing, and can judge whether people who bid below them can do so on account of some real advantage, or because, with or without knowing it, they are losing money by the transaction; in which latter case the policy is to let them lose it, while the H., O. & R. Co. devote their attention to getting contracts in which there is at least a living margin.

I give on the next page the blank form which is given to the men in the shop. The foreman stamps upon these blanks the words "planing," "turning," "drilling," etc., to denote the character of the work, and when approved by him, these blanks go to clerks who enter the facts in proper order in the books referred to, along with costs of material. Two clerks do the work for about 300 men.

When I talked afterwards with Mr. Lane, of the Lane & Bodley Company, about costs, I found him to be also much interested in them, and to be in the midst of a scheme which he hoped to inaugurate in his works, and which he also hoped would be the most perfect thing in the way of a shop cost system that had yet been devised. I cannot give a full account of it; but one of its prominent features is that it is supposed not merely to indicate at the end of the year whether there has been a profit or loss, and how much, but to show the actual state of affairs continuously, balancing actual receipts against expenses.

An unique feature of the scheme is that it does not involve taking an account of stock and estimating the value of finished or partially finished work, but assumes that labor paid for has been productive, and that the values created by it actually exist and, if not sold, are yet in the shop and can be counted among the actual assets of the concern. This seems a somewhat bold idea; but after studying the matter considerably I cannot see that there is a flaw in it, and, curiously enough, it exactly squares with the teachings of those modern political economists who combat the time-honored and generally accepted theory of the "wage fund," and point out that wages are paid not from a fund which existed before the labor was performed, but from values actually created by that labor before the wages are paid, and that where money is paid out in wages before the money is again received for the product of labor, what really takes place in the interval is not a lessening of capital, but a change of its form, i. e., from an accumulation of money to a stock of cotton cloth, pig iron or steam engines, actual values in these being created by labor before labor is paid for them.

SOME LARGE AIR HOISTS.

To return to the shops of the Hooven, Owens & Rentschler Company. This is one of the pioneers in the use of compressed air for hoists. They put in these hoists eight or nine years ago and, Mr. Richter informed me, took out some patents on some features of them which he thought were now being generally infringed, but which they had no intention of prosecuting, since they had their hands pretty full with the work of supplying Corliss engines, and did not care to bother with other matters. Their engines are mostly installed to drive generators and their business has outgrown their present quarters, and the size and weight of the castings they have to handle have outgrown their hoisting facilities, though these latter are quite unusual for air hoists. They have hoists with cylinders 24 inches diameter and 6 feet long, and as they use air at 95 pounds pressure, it will be seen that such a hoist will handle weights of something over 20,000 pounds. Their method of getting air into and out of this cylinder is very simple. At various points they have pipes in which the air pressure is maintained, and to these they attach rubber hose such as is used by the railroads for air brakes. They use the regular air-brake connections for connecting this hose to the hoist, and one valve admits air, while a spring check valve, which can be forced open by direct pressure of the hand, allows air to escape at any desired speed when the load is to be let down. It is a very simple affair, very quick and very easily managed.

No..... .....189....

THE HOOVEN, OWENS & RENTSCHLER CO.

Time Credit of.....

JOB WORK.

Symbol.	No. of Pieces.	Name of Pieces.	No.	Hours	Number. of Job.	Remarks.
		Total,				

Approved,

.....Foreman.

AN UNIQUE SUBSTITUTE FOR BEVEL GEARS.

In another Hamilton shop a friend of mine showed me a thing made of two thread spools with a lot of wires passing through them, and looking something like Fig. 1. This is a puzzle, and it turns out to be an inventor's model of a right-angle coupling, or a substitute for bevel gears. The two spools are each mounted on a wire bent at right angles, as shown, and passing through the original holes in the spools. The other smaller wires are also bent at right angles, and pass through holes drilled for the purpose. When either of these spools is rotated upon the central wire, the other spool also rotates, being driven by the smaller wires, which turn and slide in an orderly yet, at first, bewildering manner.

At the Niles Tool Works I was afterward shown one of these couplings at work transmitting power from one shaft to another at right angles to it. The spools were in this case replaced by cylinders perhaps 18 or 20 inches diameter, and the wires were about 1 inch diameter. It was working very smoothly and making absolutely no noise. The coupling was cased up and arranged to be deluged with oil, and was declared to be an entirely satisfactory arrangement. I am not informed how much power it is transmitting, nor what promise of durability it gives; but with ample strength and wearing surfaces it ought, in some cases at least, to prove a very satisfactory substitute for bevel gears, especially where there is nothing but a drill press and a lathe to make them with.

A RACK CUTTER.

Not long since the people in the G. A. Gray Company's shops were confronted by the fact that they must improve and add to their rack-cutting facilities, and they concluded to build a machine. As we all know, this shop builds nothing but planers, and believes in them thoroughly, Nothing could be more natural than that this new rack cutter should resemble a planer, not only because in a planer shop we naturally think along the line of planers, but also for the more potent reason that patterns, and possibly castings, were on hand for the job.

The blanks to be cut are chucked on the platen of this machine in the usual manner, as though they were to be planed, but the platen is moved only to index the teeth, and the head which carries the spindle and cutter arbor takes the place of the usual saddle and is fed along the cross-rail for the cut. This involves considerable overhang for the cutters, besides demonstrating more clearly than ever what they, of course, previously knew, i. e., that planer housings have no great lateral rigidity—are not designed to take strains in that direction. These would be considered entirely satisfactory, however, in many shops where the terms "rigidity" and "strength" have not the same meaning as here, and would be entirely satisfactory here, perhaps, were it not for the

fact that Mr. Ernest Richter, who presides over the drawing-room, struck a scheme in planning the machine which involves pretty heavy cuts. Their racks are cut upon the diametral pitch system, and the number of cutters used, and consequently the number of the teeth cut simultaneously, corresponds to the pitch, i. e., on a two-pitch rack two teeth are cut, on a four-pitch rack four teeth, and so on, using a corresponding number of cutters in each case. This resulted from a consideration of the fact that about equal cuts are thus taken for all the pitches, and led to an indexing scheme, the cardinal principle of which is that the index movement is always the same, no matter what the pitch of the rack may be. This results from the simple fact that, taking any diametral pitch, the equivalent circular pitch multiplied by the number representing the diametral pitch gives the same quotient in any case.

The details of the machine, which cannot be given here, are worked out with remarkable skill and ingenuity, and it represents that very large portion of the product of machine shops which the general public knows nothing of, because the machines are not made for sale, but yet which, it is safe to say, represents fully as much expenditure of brain work as is embodied in the more familiar machines that are allowed to go outside the doors of their makers.

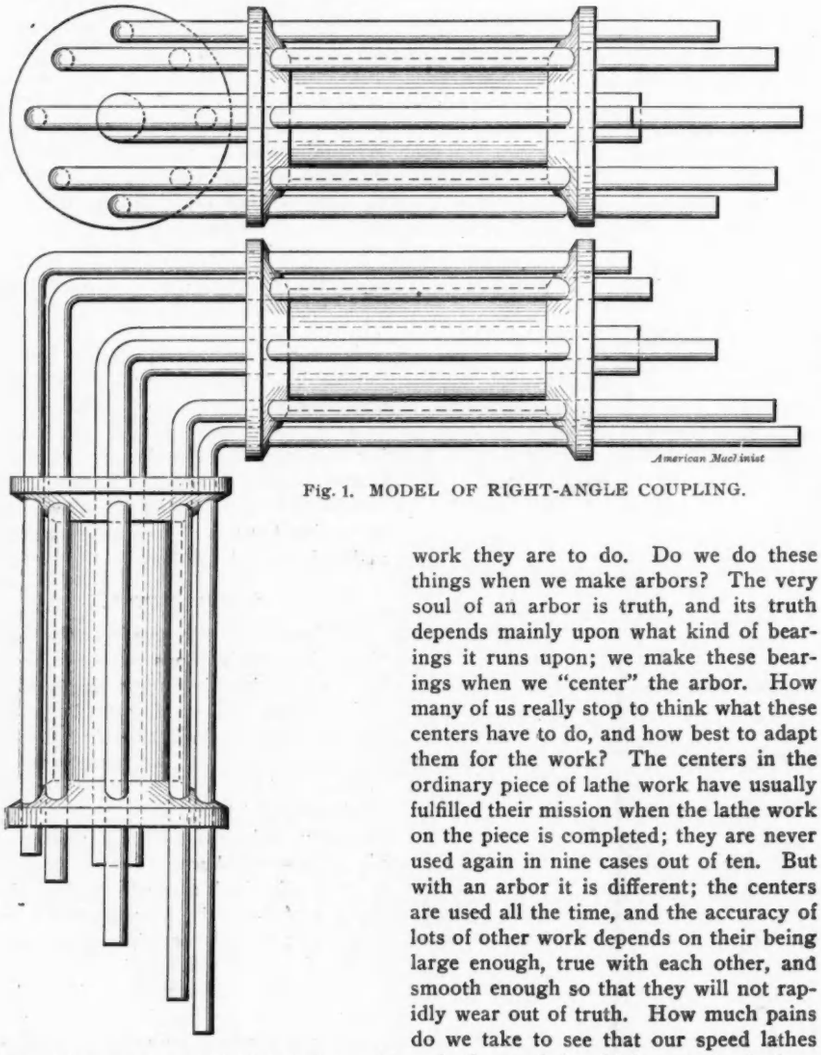


Fig. 1. MODEL OF RIGHT-ANGLE COUPLING.

THE CENTERS OF ARBORS.

It strikes me, Mr. Editor, that our treatment of the arbor question is in many respects somewhat queer. We machinists are apt to pay considerable attention to journal bearings for machinery. We usually take pains to have them in line, smooth, and of the proper size for the work they are to do. Do we do these things when we make arbors? The very soul of an arbor is truth, and its truth depends mainly upon what kind of bearings it runs upon; we make these bearings when we "center" the arbor. How many of us really stop to think what these centers have to do, and how best to adapt them for the work? The centers in the ordinary piece of lathe work have usually fulfilled their mission when the lathe work on the piece is completed; they are never used again in nine cases out of ten. But with an arbor it is different; the centers are used all the time, and the accuracy of lots of other work depends on their being large enough, true with each other, and smooth enough so that they will not rapidly wear out of truth. How much pains do we take to see that our speed lathes and other tools in which centering is done are made and kept in precise alignment, so that centers can be reamed true with each other, and how often are centers in work that has been hardened, lapped afterwards to make them true? The centers in an arbor may be all right for the work of turning the arbor, but totally unfit for the work that is to be done on the arbor afterwards. When an arbor is hardened after being turned, it usually springs out of true more or less; we then grind it to make it true, and we too often entirely overlook the fact that when the arbor sprung it simply threw the centers out of line with each other, so that they could by no possibility have a fair and even bearing on the centers of the grinding machine. This accounts for a good deal of the trouble experienced in grinding work true, and it also sometimes accounts for the fact that arbors do not stay true after they are ground. The remedy is to be found in lapping, and this can usually be done best by simply making a lap out of a piece of copper wire held in a drill- or a split-chuck and turned to the proper angle. This should then be used where it has been turned, and, charged with flour of emery and oil, it will soon lap the centers smooth, true and round, but, best of all, in line with each other, so that they will have a true bearing on lathe or grinding machine centers, and will be much less likely to wear out of truth. It pays to do the same thing with some other work besides arbors where great accuracy is required.

S. T. FREELAND.

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English and American Locomotive Practice.

Under the above heading we find an article in the English "Practical Engineer," from which we made the following extracts. The writer, it is clear, has both an accurate knowledge and an exalted opinion of American railways (!) Of course, the crooked and rough tracks of our pioneer roads account for the adoption of the flexible wheel base; but the explanation offered for our use of bar frames, outside cylinders and steel fireboxes is really funny:

"There are always a number of engineers and others who propose either to adopt American types of locomotives on English railways, or vice versa. They do not seem to appreciate the fact that almost every difference in the practice in the two countries is simply the outcome of different conditions of work.

* * * *

"In the first place, one of the most fundamental differences is in the framing, the Americans using the bar frame, which is practically unknown in England at the present time. The reason for this is not far to seek. If we were to run an engine on an average American road, with a frame consisting of plates and angles fastened together with a large number of rivets, such as is the usual English practice, we should soon find every rivet loose, and the whole engine shaky and rattling. This is sufficient to explain the reason for the adoption of this type in America.

* * * *

"Most other difficulties will be found to be based on the fact that it does not pay to spend nearly as much money over a locomotive in America as it does in this country. If an engine is to be shaken to pieces in the course of seven or eight years, or runs a chance of getting off the road, perhaps over a bridge or down an embankment, a few hundred miles from the nearest breakdown gang, first cost is

obviously an important consideration. Hence the outside cylinders (avoiding the expensive crank axle), the cast-iron or malleable-iron steam pipes, the cast-iron wheels, the steel fireboxes and a host of minor details.

* * * *

"Examples could be multiplied *ad lib.*, but we think the above are sufficient to fully bear out our general statement, and to demonstrate the advisability of seeking out the reason of any particular construction before demanding its adoption under conditions different from those it was designed to fulfil."

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Small Crank-Driven Colburn Keyway Cutter.

The larger sizes of the Colburn keyway cutter drive the cutter bar by a rack-and-pinion movement; but for the smaller size, shown by the accompanying engraving, a crank motion is considered better.

The crank disk is covered by a door which closes in front of it, and when this is open the crank pin can be readily set for any required stroke up to slightly more than 8 inches, which is the maximum length of keyway intended to be cut by the machine.

The cutter bar is overhung towards the front of the machine, so that chips clear the bearings and working parts, and the machine is provided with the same devices for facilitating clamping of work, setting for tapers, and feeding accurately to predetermined depth, that have been mentioned in connection with the larger machine described in our issue of May 28th.

Where the work to be keyseated is bored, and not faced on the hubs, centering bushings are used which fit central with the cutter bar in the plate shown on top of table in cut. These bushings are made to fit into the bore of the piece to be keyseated, and consequently will chuck the same accurately, and the keyway can be cut true without facing the hub. The machine will cut keyways up to ⅞-inch wide, and will take a pulley or similar piece 14 inches wide under the arm.

The machine is made by Baker Bros., Toledo, O.

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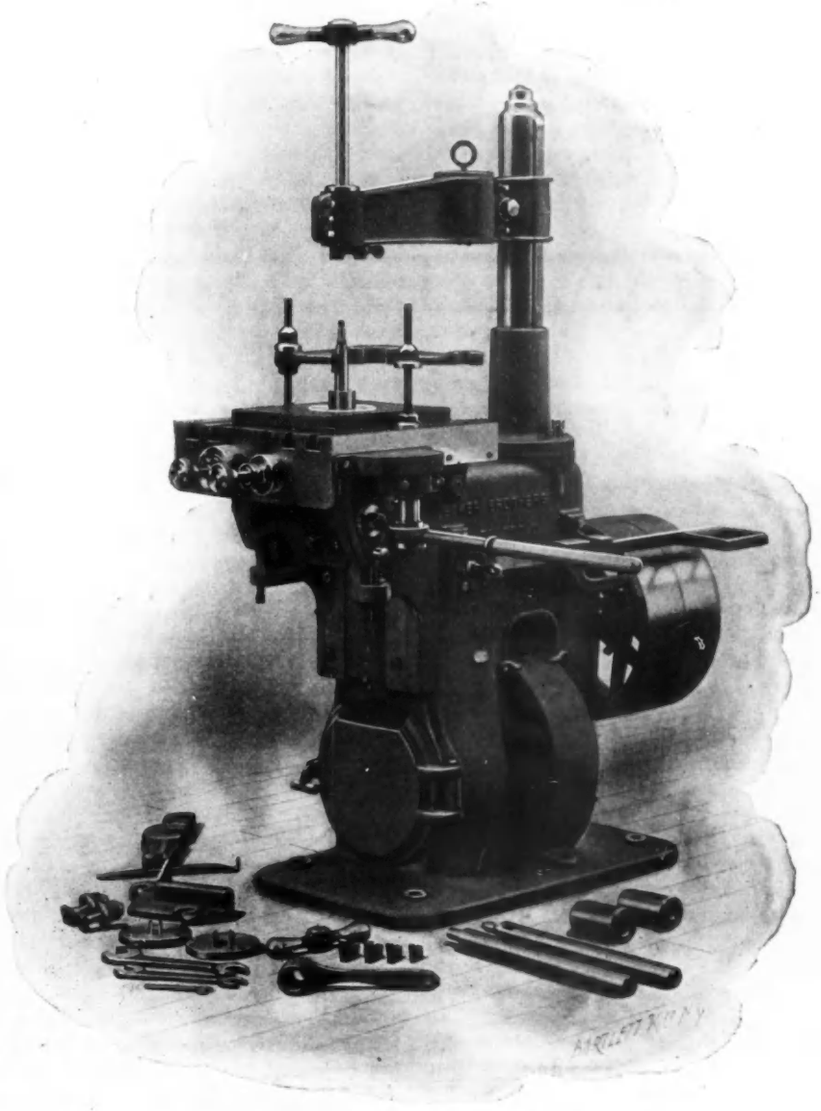
Pump Balancing.

In an ordinary two or three throw pump the equalization of the load and duty is accomplished, so far as it can be, by arranging the cranks suitably upon the shaft. In the single-barrel pump, of the variety placed down a bored well, no such means of balancing are available. Yet it frequently happens that such a pump is required to be driven by some small motive power, the regular turning of which might be seriously affected by the total load of the pump occurring upon the up-stroke only, the down-stroke being, in fact, hastened by the weight of the rods, bucket and other details. Moreover, when unbalanced, the whole load comes upon the crank pin, which is subjected to heavy wear. If the crank pin and shaft be made equal to the duty thus put on them, a perfect balance can be secured by placing another crank on the shaft, directly opposite the working crank, and suspending to it a weight equal to the balance required. This may often be a cheap method, but it is not one that suggests itself to everyone as a neat method.

To balance a pump demands that the duty of the crank pin on the up and the down strokes shall be equal, and to carry this out demands that the whole of the rods, bucket guide and sling or connecting rod which hang from the crank pin shall be counterweighted so as to render these parts neutral as regards gravity. The crank pin is to be entirely relieved of their weight by exerting an upward pressure at the crosshead exactly equal to the downward pull of the weight. In addition to this a further balance is required equal to one-half the weight of the water upon an area equal to that of the bucket. This distributes the work over the whole revolution as nearly as it can be distributed. As an example we may suppose a pump having a diameter of 8 inches and a lift, including the lowering of the head in the bore tube, of 100 feet. Assume that the total load of rods upon the crank is 560 pounds, of which 420 pounds is immersed in the water in the bore tube. Then we will take off one-seventh of this latter weight for flotation, leaving just 500 pounds of metal to be balanced at the crosshead. In 100 feet of lift of an 8 inch bucket the weight is 2,133 pounds, or the lift in yards multiplied by the square of the diameter in inches. One-half this is 1,066 pounds, to which if we add the 500 pounds found above we get 1,566. We will allow the balance weight to be placed upon the end of a lever, the other end of which is linked to the crosshead of the pump, and the intervening fulcrum is

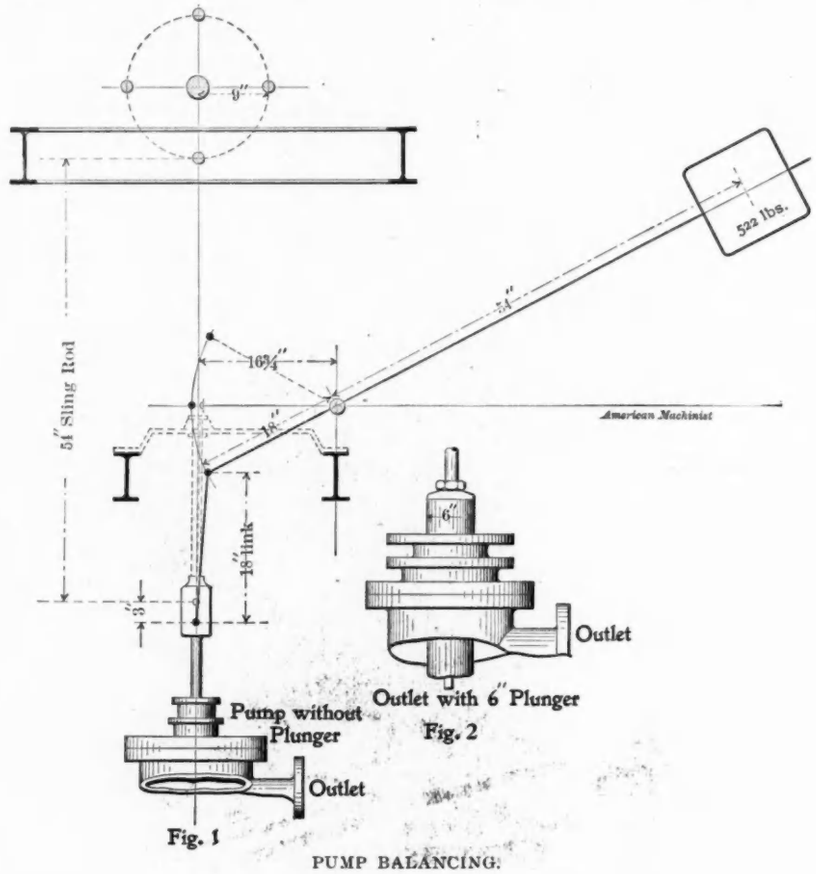


CRANK-DRIVEN KEY-WAY CUTTER.

placed, say, one-fourth the length from the end. The balance weight has thus a leverage of 3, so that if we divide 1,566 by 3 we get 522 as the weight of the balance bob to be hung on the balance lever.

The accompanying sketch shows this arrangement of pump. A second pin is put through the crosshead below the main pin of the connecting or sling rod. Links about equal to the length of stroke, say 18 inches, extend upwards from this pin to the end of a balance lever, the short end of which is 18 inches long, and the long end, say, 54 inches to the center of gravity of the weight.

Where the water has to be delivered above the surface it may be utilized to assist in the balancing. In case of the water being delivered at a height above the surface equal to the lift from below, then the use of a plunger at the surface, having the same diameter as the bucket, will exactly halve the duty of the pump on its up and down strokes, and if the lift above the surface is greater than the lift below, even the rods, etc., may be balanced by the water. A high lift above the surface in fact enables one to entirely dispense with any balance weight at all, and the plunger may even require to be made less than the bucket. There is apt to be some trouble with plungers in unskilled hands, owing to the danger of overscrewing the gland and so putting a heavy stress upon the machinery, and it is perhaps as a rule better practice to make the plunger smaller than the bucket, and make up the deficiency of balance by a weighted lever. We may suppose the pump of our sketch to be required to force water 20 yards above the outlet at the surface, and we will give the plunger a diameter of 6 inches. Then in measuring the duty we have first the same old weight of 500 pounds for the rods, etc. We have then 2,133 pounds of lift on the up-stroke up to the surface, or yards of lift $\times$ diameter^2; that is, $33\frac{1}{3} \times 8^2 = 2{,}133$ pounds. Above the surface we have a further lift of 20 yards multiplied by $(8^2 - 6^2)$, or $20 \times (64 - 36) = 560$ pounds. The load is that upon the difference of the bucket and the plunger. The total lift load of water is thus $2{,}133 + 560 = 2{,}693$ pounds.



PUMP BALANCING.

Upon the down-stroke the plunger acts and is loaded by the 20 yards of water above it, this pressure being thus $20 \times 6^2 = 720$ pounds. Subtracting this from the load on the lift stroke gives $2{,}693 - 720 = 1{,}973$ pounds, one-half of which, or 986 pounds is to be balanced. Thus the total balance is $986 + 500 = 1{,}486$. Dividing this by the leverage 3 gives 495 pounds of a weight. Any little regulating can always be made by sliding the weight to and fro upon the lever.

It is by no means always a necessity to secure this full balancing; often a mere relief of load is sufficient; but this entirely depends upon the conditions as to the driving force and the desire to have regular turning. There are men who will argue that the water column presses upon the bucket during the down stroke. This is, of course, impossible. When the bucket descends it has a large hole through it, for the valve on it opens and the lower valve then carries all the load of the water.

In these deep single-barrel pumps there is a certain advantage in the plunger, for upon the down-stroke, if from any cause the bucket should tend to strike in its descent, the advancing plunger would assist to move it forward; for when a bucket does not move, its valve is shut, and the load of the column of water would move the bucket again, though as soon as moved its valve would perforce open. Because of the necessity of stopping the descent of the rods on the down-stroke, I do not think it bad practice that the plunger should descend into a part of the outlet casting, very little larger in diameter than the plunger, for the last portion of the downward stroke. The resistance of the water flowing up in the small annular opening thus remaining for its passage would bring the moving parts nicely to rest.

There are some engineers who will balance any pump which delivers above the surface, entirely by the plunger, which they will make as much larger than the bucket as is necessary to secure the balance. The difficulty, and I think, danger of this is the fact of the influx of the water from the delivery main to fill the space in the using main, which represents the difference in the volumes of the bucket and the plunger displacements; for with the plunger of larger diameter there must be a reflux. This will set up oscillation of the water in the main. If such a mode of balancing is desired this oscillation should be prevented, and though I have never tried it, it appears that it might be avoided by placing a reflux valve in the delivery pipe and a capacious air vessel between the valve and the plunger casing. The elasticity of the large air vessel would not materially vary, if the compression of its contained air was a good ratio to the plunger's excess of displacement. The reflux valve would be simply pushed back by the pressure. In fact, the air vessel would be utilized to maintain a balancing pressure in the rising main, which, acting on the difference of area, would uphold the load to be balanced.

For testing the yield of a bore hole, it is often necessary to use simply a hand pump. Now, when the water level is deep below surface, it is very cumbersome to balance all the weight of the ends and half the water by means of weights on the pump handle, for such weights have to be started into motion and the stress is great. In such cases I have found it exceedingly convenient to attach to the head of the pump rod, just below the point of attachment of the handle, a rope carried upwards and attached to a long coiled spring, which I pull to such a degree that it nicely bal-

ances the load. For an ordinary hand-worked pump such a spring, about 18 inches long in the coil and 1½ inches outside diameter, will do good work.

Indeed, for many cases of balancing, where it is not a question of preserving an unchanging center of gravity, springs have great advantages over weights, which, indeed, are often quite inapplicable, as, for instance, in balancing a falling weight. A spring will check a falling weight, where a weight hung over a pulley and moving the other way would not only inconveniently reduce the speed of falling, but just at the last moment would fail to act by reason of its own momentum upwards.

Springs would perhaps hardly be considered suitable to balance a permanent pump, but there is no reason in principle why a pump should not be balanced by coiled springs sufficiently long, so that the length of the stroke was not too great to vary the tension of the stretched spring, so as to render it too weak at one end of the stroke and too strong at the other end. The entire strength is always required at the lower end, of course, where it is useful to give the column of water its upward start, and thus, if properly designed, the spring might be made to very nicely assist the working of a pump.

As aluminum grows cheaper, it seems probable that hollow rods of this metal could very well be made with so much flotation in themselves as to even assist the lifting of the water. Such rods, with a bucket loaded to pull them down, would work nicely and not be liable to buckle.

W. H. Booth.

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The Western River Steamboat and Its Engineers.

The following remarks were contributed by the late J. F. Holloway, in connection with the paper on "The Western River Steamboat," presented by Mr. W. H. Bryan at the St. Louis meeting of the American Society of Mechanical Engineers, and reprinted in our issue of September 10th. The peculiarities of the steamboat of the Ohio, the Missouri and the Mississippi rivers, and its adaptation to the conditions of its service, seem to have been completely vindicated. The late Mr. Holloway shows himself here both the experienced and critical engineer and the graphic verbal delineator. Mr. Holloway's remarks were not delivered at the meeting referred to, but were contributed later:

"It is often considered quite the thing, by many persons, to speak in a derogatory manner in reference to what has been accomplished in the West, especially in matters pertaining to engineering, and of the men there engaged therein, and this, too, without a full understanding of the circumstances under which the work was done, or the service which it was expected to perform. Anyone familiar only with the steamboats now in use on the Eastern rivers and Long Island Sound, and who had little or no acquaintance with the navigable rivers in the West, may, perhaps, be excused for any disparaging remarks they may be disposed to make when for the first time they see and examine a 'Western river steamboat,' for the reason that, as the splendid boats with which they are familiar are the outgrowth of many years of change and improvement, they cannot understand why the Western steamboats have been exempt from similar changes, and why to-day they bear so close a resemblance as they do to the boats which floated on the same waters thirty or forty years ago. Having several years ago had opportunities of observing navigation as conducted on the Ohio, Cumberland, Tennessee and Mississippi rivers, I learned something of the difficulties with which the old-time engine builders and the builder of their hulls had to contend, and I also learned that as there had been no change in these rivers (except for the worse) since the early days when steam-driven boats first began there their struggles against strong currents, were swung around their abrupt bends, or were dragged over their shallow bars, that there could be little or no change now made either in the hulls of the present boats or in the engines that propel them. To comprehend the reasons which govern the design and construction of steamboats for use on Western rivers, one should have an acquaintance with the rivers themselves. It would be an easy task to build a boat which would navigate them when their channels are filled with water to a depth of from twenty to fifty feet; it is quite another matter to make the same boats carry any considerable cargo when these waters have fallen to a depth of from twenty to fifty inches, or even less. The apparent want of change or improvement in the construction of these river steamboats, and which in all respects are so unlike the changed and improved steamers which now float upon the deep Hudson or the adjacent Sound, is not due to the stupidity or want of skill in the engineers and builders of the present, but is due rather to the skill and ingenuity of the engineers and builders of the past, who did their work so well that no considerable improvement is now possible.

"The problem of carrying the largest possible load on the shallowest water is one which permits of no question, either as to the model or as to the construction of the boat as a whole. The model must be one which will displace the largest amount of water for each foot, or inch, of submergence, within the limit of the length and beam given, and the hull must be made of the lightest, scantiest material possible, and still hold together. All such stiffening devices used in other hulls, and known as main, center, sister or side keelsons, are unknown, as such, in the Western river steamboats, and indeed would be a disadvantage, as they would make the hull too stiff and rigid to allow of being dragged over sandbars by the use of derrick spars, much as a lame man makes progress by the aid of crutches under his arms. The economy of weight in the hull is also observable in the constructions of the cabin, whose stateroom partitions and other parts are all made up of the thinnest boards obtainable, and where the wood brackets, ornamental or otherwise, are examples of what a scroll saw can do and still leave something visible. In order to get the most power with the least weight, horizontal boilers having in them large return flues are used, which hold but little water, and whose small shells are made out of as light plate as can be used and pass inspection under the high pressure which they carry.

"Were it not that the water used in these boilers is often very muddy, other and still lighter types of boilers would no doubt be used. The same controlling conditions permit the use of non-condensing engines only, and as the steam cylinders of these engines are the heaviest part of the engine, they are supported on long wooden frames or bed-plates, which rest upon the floor timbers of the boat, and are notched on them, and thus carry their weight much as one would use a long ladder to carry a weight over thin ice which otherwise would break under the load. The long wooden connecting rods, or 'pitmen,' as they are called on the Western rivers, are made out of the lightest, driest pine to be had, and are strapped on either side with the thinnest iron allowable, and they convey in a horizontal position the power of the steam cylinders to the cranks on the shafts of the side or stern wheels. These wooden 'pitmen' have long been a standing object for criticism, and a topic for ridicule with many 'new engineers,' as a relic of engineering barbarism, and yet I fancy no possible combination resulting from engineering refinements can construct a substitute which will produce as good results in the same place, for anything like the same weight, stiffness and cost. The valve gear of these engines, when compared with the elegant and exact devices employed on modern engines of the Corliss type, or those using elaborate and costly cams, or wipers, it must be confessed do look crude, inaccurate and rough; and yet under conditions where the most refined modern valve gear would prove a lamentable failure, these old and crude devices are a success. The reason which induced the builders of engines for these Western river boats to adopt such peculiar construction could hardly be made clear without a careful description of the hull of the boats, and of the varying conditions to which both engines and hulls are subjected, and under which they must operate. The steam cylinders are placed on foundations as unstable as would be a raft, their alignment is varied by the addition or removal of every ton

of freight which the boats carry when afloat, and they are further distorted in all directions when aground, or when the boats are being dragged over sand-bars having several inches less of water on them than is required to float the hull. While the calm study of the machinery of a Western river steamboat while at rest would be an interesting object-lessson to anyone at all interested in such matters, it can only be seen at its best at a time when some rival boat is striving with it for 'the broom,' and close behind is slowly gaining, with roaring furnaces and chimneys belching out vast volumes of thick, black smoke; when all on board, from the pilot above to the fireman below, are worked up to the highest pitch of enthusiasm, and when engines, boilers, engineers and all concerned in the management of the boat are called upon to show the stuff which is in them.

"I know of no more exciting scene than was often to be witnessed in the days of the old famous river packets, which used to ply between New Orleans and the lower Ohio River ports, when a 'ten-boiler boat' was trying to make a record, or take a wharf-landing away from some close-following rival steamer. To stand on the boiler deck at such a time on a big side-wheel-boat, when in order to get ahead the pilot had made up his mind to close-shave a 'towhead,' or take the dangerous chances of a new channel or a new 'cut-off,' and when all on board well knew the risk he was taking, and were standing by to help him through, or help themselves if he failed, was exciting to a degree. Then it was that the two most skillful and daring engineers were called on watch, and took their stand alongside of their respective engines, stripped like gladiators for a tussle which soon came as the clanging starboard bell rang out to 'slow down,' and the hasty ringing of the 'jingler' over the port engine meant 'crack it to her.'

"Then, as the bow of the big boat swung, all too slow to suit the emergency, or the impatience of the pilot, a stopping starboard bell would ring, quickly followed by a backing one, which set the engineer to wrestling with his 'hooks,' one of which he hangs up with a cord, and the other he picks up seemingly from somewhere on the platform. As the suddenly stopped and quivering wheel in the swift-flowing current hangs for a moment poised on the center, the engineer, grasping his ever-at-hand club of wood, quickly thrusts it between the uprising rocker arm and the lever that lifts the inlet poppet valve, to which widened opening of the steam-valve port the engine responds with a noise of escaping steam not unlike the roar of an enraged elephant when prodded with the iron hook of his keeper. The battle of the bells, thus begun, waxes more fierce as the excitement increases. There are bells to the right, and bells to the left, and amid their discordant jangle the engineers are working like mad as they clutch the throttle valve, open or close 'the bleeder,' hook her on 'ahead,' or stop, and back, in such rapid succession as that soon neither they, nor anyone else, can tell how far behind the bells of the pilot they are. Then soon, amid the wild roar of the pent-up steam as it rushes from out the safety-valve pipes, the exploding exhausts of the engines which at the end of each stroke sound as if a cylinder-head had blown off, and to which is added the shrill noise of the warning bell which calls to the firemen to 'fling open the furnace doors,' there comes from out a huge trumpet-mouthed pipe above the head of the engineers, and which leads up to the pilot house, a hoarse shout, heard above all else, partaking alike of command, entreaty and adjectives, urging something or other to be done, and done quick, else the boat and all on board in a brief time will land in a place which by reason of the reputed entire absence of water could not well be called a 'port' (and certainly is no port mentioned in the boat's manifests). This battle of the bells, and irons, goes on until, if in a race, the rival boat is passed, or crowded on the bank, or the narrow channel widens out into the broad river, when the discordant jangle of bells gradually dies out, the tired engineer drops on the quieting 'cut-off hook,' lays by his emergency wooden club, and wiping the sweat from his heated brow, comes down from the footboard to catch a breath of the cool air which sweeps over the guards, and to formulate in his mind the story which he will have to tell of the race just over, or the perils just past. But the famous old-time flyers which before the War tore their way up and down through the muddy waters of these Western rivers are all gone; the marvellously skilled pilots of those days have gone too, who, through the darkest hours of the darkest nights, knew to within a few feet just where their boats were, and what was on the right or left or beneath them which was to be shunned. The engineers, who, with a courage born and nurtured amid the vicissitudes of a backwoods life, and with an experience and skill the outgrowth of trials and dangers gone through, have also passed away, and to the generation of the present are unhonored and unknown, as are the men who designed and built the hulls, and the workmen who with crude and scant tools built for them the machinery they so well planned and handled.

"Who they were, and where they lie, is known to but few, if any. Did I but know their final resting-place, I would, like 'Old Mortality,' wish to carve anew, and deep, the fading records of their life and death, which time has so nearly obliterated, and to herald abroad the praise and honor due them as the designers, builders and engineers of the old-time 'Western river steamboats.'"

Work at the Washington Gun Factory.

In the annual report of the Superintendent of the Naval Gun Foundry at Washington, D. C., we find that, during the year, the guns manufactured have been nearly all 8-inch caliber or below.

The forgings for eight 13-inch guns for the "Kearsarge" and "Kentucky" are being delivered. Four 12-inch guns have been completed for the "Iowa," and are still in the yard. One 10-inch Wurst gun has been completed during the year.

Seventeen 8-inch guns have been completed during the year, 16 of which were for the "Brooklyn" and "Iowa." Eight 8-inch guns are under construction, for use on the "Kentucky" and the "Kearsarge." Those intended for the "Brooklyn" have been forwarded to Cramp's shipyard to be installed, while those for the "Iowa" are being proved.

A 30-caliber 6-inch gun belonging to the "Chicago" has been converted into a rapid-firing gun with the Fletcher type of breech mechanism.

Fourteen 5-inch guns have been completed during the year, and thirty-four more are assembled.

Thirty-seven 4-inch guns have been completed, twenty-four are in an advanced stage, and fifteen others are in process of manufacture.

Forgings for fifty 3-inch guns have been received, and three are completed. Work on the others is well advanced, all being rifled and chambered.

The department has prepared specifications for new cupolas and blowers, electric crane and runway, jib cranes, elevators, etc., for use in the foundry and the articles required have been advertised for.

The number of men employed has reached a monthly average of 823½.

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A friend sends us a clipping from a newspaper which states that a young engineer has patented a remarkable invention, which, it is declared, removes the last vestige of risk of boiler explosions. The invention consists of some sort of an alarm which is sounded when the pressure reaches a certain point, and it is believed that the boiler insurance companies will insist upon its adoption. We have been possessed with the idea that a good safety valve, lifted from its seat every morning by the engineer, and known to be in good working order, is the very best sort of high pressure alarm that can be attached to a boiler. It not only makes a noise when the maximum pressure is reached, but it also prevents the pressure getting beyond the maximum, and that, it seems to us, is the important function.

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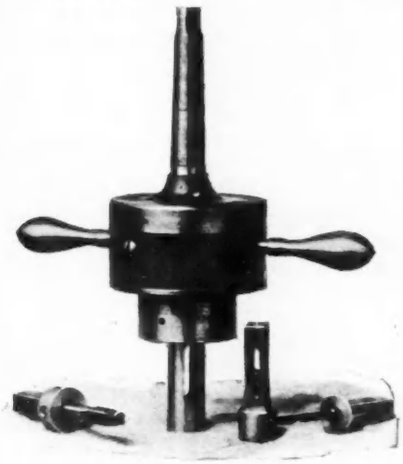
More than 700,000 actual horse-power is being developed by gas engines in Great Britain at the present time.

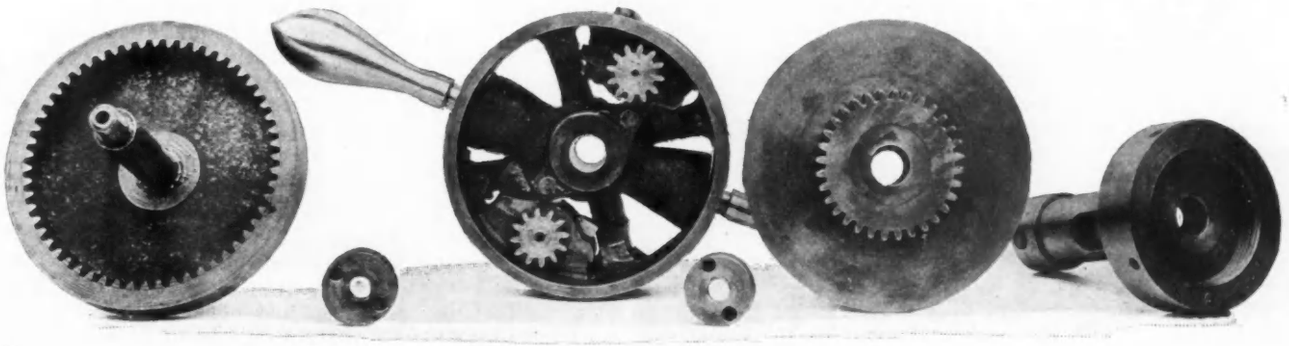
Improved Drilling and Tapping Attachment.

The accompanying half-tones show the exterior and some of the details of an improved drilling and tapping device especially designed for upright drills. It combines drill socket, tap holder, a friction drive for bottoming taps, and a reverse movement for backing out the tap. Where this device is employed, the hole is first drilled, and the drill socket is then slipped out and the tap holder is inserted. When the tap has reached a sufficient depth, the two projecting handles are grasped by the workman and the revolution of the tap is immediately reversed, and the tap continues to turn backward until it is clear of the hole or as long as the cross-handles are held from turning.

The body of the tool carries two small vertical spindles with similar pinions on each end of each of them; and internal gear on the driver or upper portion engages with the two upper pinions, while the two lower pinions drive an external gear upon the lower part which drives the drill or tap. The pinions are normally held from turning by the double cam or lever which operates upon one end of the cap of each pinion spindle bearing, the other end of each cap being adjustable from the outside by the solid-ended, screwdriver-slotted nut seen in Fig. 1.



IMPROVED DRILLING AND TAPPING ATTACHMENT.



DRILLING AND TAPPING ATTACHMENT DETAILS.

When the tool is revolving, the holding of the cross-handles gives the double cam a sufficient movement to release the pinion spindles in their bearings, leaving them free to revolve, and thus reversing the movement of the lower part.

The lower part of the tool, which receives the drill sockets or tap holders, is also held by friction, having an enlarged head and an adjustable clamping nut. The hole for the sockets is perfectly square and parallel, and the sockets may be slipped in the square either way, a little spring holding them from dropping out, but not interfering with their removal by a slight pull. The attachment as now made is furnished with two drill sockets for Morse taper Nos. 1 and 2, and a tap holder for sizes up to 1 inch. A larger size will soon be placed upon the market. It is made by the Union Tire Company, Plainfield, N. J., and is known as Fulmer's drilling and tapping attachment.

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Atoms and Molecules.

It is important to the mechanic who deals with materials of various kinds that he should know as much as possible about these materials. Scientists who study such matters give us very many interesting and useful facts regarding the constitution of matter and we find in the "Sun," of New York, an article by Robert S. Ball which ought to interest mechanics especially. From this article we abstract as follows:

The ranges of our senses lie midway between the infinite and the infinitesimal, and our reach in either direction is narrowly limited. Mathematics aid the imagination of man to pierce far into the mysteries that surround us on either hand. So guided, the mind may wander with confidence and with profit far beyond the reach of the telescope or the microscope.

It was long assumed that matter might be divided and subdivided, say by halving and halving over again any portion of matter, indefinitely. There is a natural limit to such subdivision, at least as regards composite matter, such, for instance, as paper. In the process of continuous dividing, a time would come when the two last portions would not both be perfect paper with all the characteristics and properties of that material. We should begin to obtain the separate ingredients of which the paper was formed.

It will be better therefore to assume, instead of a composite substance as paper, something that, as far as we know, is perfectly homogeneous, as, for instance, a piece of iron. We divide that until we have the smallest speck of it that our senses can distinguish, and it still has all the properties of iron. But, even with iron, if we had the means of going on dividing it until we had particles so small that they could not be detected by the best microscope in the world, science asserts that there would at last be reached a point where further subdivision would be impossible, and this last particle which cannot be cut or divided is called an atom, and all matter is composed of such atoms.

The ultimate atoms of matter are so minute that millions of them would be required to make a body equal to a small grain of sand, and the individual atoms even then can be by no means simple in structure. It is proved, as they would say in the courts, by "circumstantial evidence," or, as scientists say, by "certain phenomena" that these atoms, say those of iron, possess a highly complex character, are elaborately formed of many different portions, and in many cases are animated by rapid and intricate movements. No experience of the greater objects that our senses can perceive can afford any adequate conception of the lively activity of atoms. It is necessary to try to understand some of their varied activities.

We know something about steam. We say that work is done in the cylinder of a steam engine by the pressure of the steam on the piston, but this matter of pressure has to be regarded in an unexpected light if we consider the ultimate constitution of the steam. Water is the result of the chemical union of hydrogen and oxygen, each molecule of water consisting of two atoms of hydrogen and one of oxygen. If any subdivision of a molecule of steam could be effected, then the parts so separ-

ated would not be water, but atoms of the separate gases. The steam in the cylinder of the engine is to be regarded as a multitude of these molecules of water, each of which is in a state of rapid motion. The number of the molecules is prodigious, and as they are so close to each other, and darting about with such inconceivable rapidity, collisions are constantly occurring, each collision diverting the molecule from its course, only to encounter another collision in the new direction. It is believed that each molecule will experience millions of such collisions per second.

As the molecules of steam dash about and collide with each other, similar collisions occur against the sides of the cylinder and the face of the piston. What the engineer calls pressure is the accumulated result of the myriads of shocks from the darting molecules of water. If the heat of the boiler continues to be applied, and the steam is not allowed to escape, the pressure rises. The pressure rises because the temperature is increased. As the temperature is increased the speed of the darting molecules is increased, and consequently the number and force of their collisions, or the collective result of them, which we term pressure. There is a definite relation between the temperature of the steam and the average speed of its molecules. The increase of the velocity of the molecules means, of course, increased vehemence in the collisions or blows produced, or, taken in the collective result of the blows, increased pressure is the result.

When two liquids, such as brandy and water, are placed in a tumbler a complete mixture occurs. It makes a difference as to the way the liquids are introduced, but a most minute and perfect intermixture occurs in any case. The mixture cannot be prevented by any amount of care. If the water is poured in first and the spirit, which is lighter, as carefully as possible after, they will still in a short time mix completely.

The action is understood when we remember that each liquid is made up of these molecules in motion. Across the boundary which may at first divide the upper liquid from the lower, a stray molecule of either liquid dashes into the other, and then another, and by the incessant repetition of the process the blending is completed. As the molecules of a gas may be assumed to have a greater range of movement than those of a liquid, the mixture or union of different gases occurs more rapidly than the mixture of liquids.

It is much more difficult to think of the ultimate particles of a solid as having also this same activity. There are, however, reasons for knowing that, with organs of sense millions of times more acute than those we now have, we should find the molecules even of a piece of cold iron possessed of the liveliest movements. In the case of a solid, while these movements exist, they are more restricted than in the case of a liquid or a gas. Each molecule remains, generally speaking, in permanent association with those other molecules with which it is originally associated. If a piece of solid copper and a piece of solid zinc are placed in ever so close contact, no fusion of the two substances takes place. If, however, the molecules are given the wider range of movement that occurs in the liquid state, or if the metals are melted, then if they are brought together they soon mix intimately all through each other.

A striking illustration has been devised to show how extremely minute must be the actual sizes of the molecules of matter. Imagine a rain drop the size of a pea, and that it is magnified into a globe as large as the earth, each of the molecules of which the raindrop is composed being magnified at the same time and in the same proportion, then science says that it knows that the molecules so magnified would be larger than shot, but smaller than cricket balls.

Illustrations have also been devised of the fineness of the ultimate texture of matter. If a plate of copper by any process be rolled to a thickness equal to one ten-thousandth of a sheet of paper, the substance in the plate would still have all the characteristics of copper. It is inferred, however, from an ingenious line of reasoning, that if the plate so attenuated were to undergo a still further reduction until it was no more than one-millionth of a sheet of paper in thickness, it would then approximate to a single layer of individual molecules of copper.

The possibility of minute subdivision of matter has been illustrated in many ingenious ways. Quartz has been melted at a high temperature, and very fine fibers of it have been drawn out. The melted quartz was attached to an arrow shot from a crossbow, the flight of the arrow leaving behind it an attenuated filament of the quartz. A fiber of silk, as drawn from the cocoon, measures about one five-thousandth of an inch; but these fibers of quartz have been drawn so fine that a hundred of them twisted into a cable would be no larger than the silk fiber. These fibers have been drawn so fine as even to elude the ken of the finest microscope. These things demonstrate the extreme subtlety of the molecular texture of matter. The quartz fiber only one hundred thousandth of an inch thick possesses all the properties of the original rock from which it was fused.

It is not easy at once to see the practical bearing and value of the investigations and speculations that lead up to these views of matter. And yet hints of the importance of the molecular functions are very near us. The ability of the sun to transmit its light and heat are entirely dependent upon the smallest material objects. The solar radiation is received in the form of waves transmitted through the mysterious ether which seems to fill all space. The waves leave the sun with an energy which carries them across the 93,000,000 miles that intervene. The sun is at a temperature so high that the outside of it at least is in a gaseous state. The molecules of these gases are dashing about with a speed corresponding to the high temperature.

Though an atom is so minute, it is still, in some cases, at all events, of a highly complex character. Portions of an atom are free to move relatively to other portions. The atoms quiver under the successive collisions, as elastic bodies do. The most perfect type of an elastic body may be illustrated by the deportment of these atoms. The rapidity of their movement differs somewhat for molecules of different substances. The molecules seem to have the power of transferring part of the energy of their vibrations to the ether and originating waves that reach the earth as light or heat.

This is the merest outline of the physical cause of the radiation of light and heat. Going into the details of the subject, points arise that are connected with some of the most remarkable developments of modern science. The sun contains large quantities of hydrogen with its atoms vibrating in the manner described. These vibrations are known to be of a manifold character. They seem to have different times of movement, and thus produce different styles of undulations of the ether. That beautiful and wonderful instrument, the spectroscope, takes a bundle of these waves and sorts them out into their different types. Besides those waves which can be rendered visible to our eyes, there are other waves transmitted from the same atoms which are unable to appeal directly to any of the human senses, and these, nevertheless, are able to impress themselves upon the photographic plate. The photographic spectrum of hydrogen contains a multitude of lines, each corresponding to a distinct form of ethereal undulation, and thus we obtain some idea of the complexity of the atom of hydrogen gas, and how, though so minute, it is still able to give rise to so many different forms of ethereal agitation.

Every other element is also able to produce waves in the ether as well as hydrogen, and the waves that arise from each element are, generally speaking, so entirely distinct from those produced by any other element that we are able to ascertain what the actual substances are which compose the sun. In some cases the spectra of the elements are extremely complicated, thus indicating a corresponding complexity in the atom belonging to the element. The molecule of iron must be of a very elaborate character, for its spectrum contains far more lines than that of hydrogen. Thousands of lines, indicating the existence of thousands of distinct waves, take their origin from this little atom belonging to the most common of metals. The more we learn of the multi-

mate texture of matter, the more amazing seem the properties of those atoms which are the smallest of natural objects.

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A Self-Adjusting Friction-Clutch Coupling.

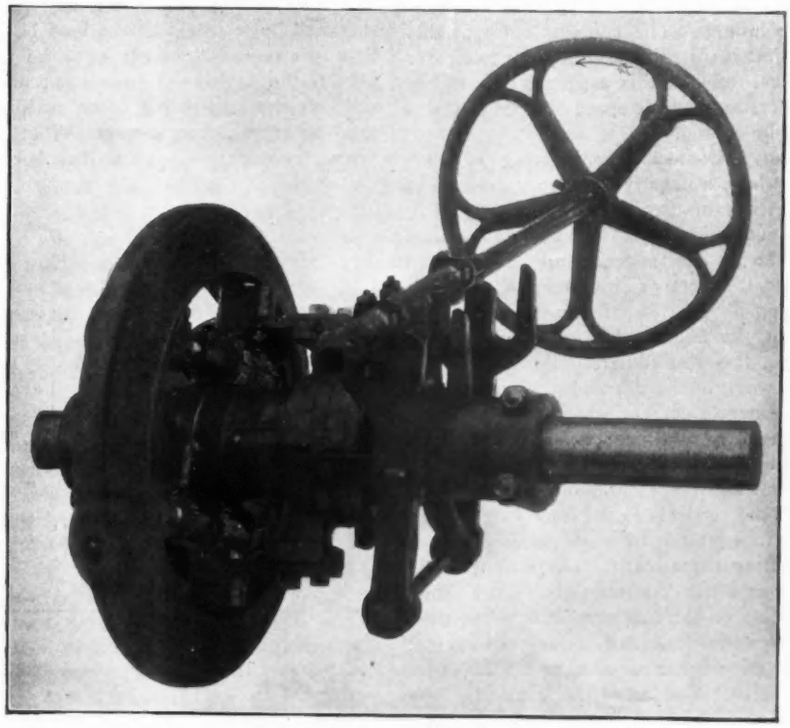
The friction-clutch coupling shown in the accompanying half-tone seems to possess some desirable features not heretofore attained. Many friction clutches are in use that may be thrown in or out as desired, but which require readjustment from time to time to compensate for wear or to enable the clutch to securely drive a greater load. The present clutch may not only be thrown in or out as desired, but it may be adjusted for wear or set up with more or less tension as required without stoppage, either section of the clutch may be the driver, and it may be applied under any of the usual conditions where friction couplings are employed.

The main casting of the clutch consists of a large ring with an interior V-surface, the angle usually employed being 60 degrees. This ring is attached by suitable arms to a hub keyed to the end of a shaft, the arms being at the back of the ring and leaving the interior and the front side of the ring open. The friction pressure is applied by two opposite shoes, which slide upon a casting having a hub which is keyed to the end of the other shaft. These shoes have wooden rubbing surfaces, and they are distended by two screws, one right-hand and one left-hand, attached to each shoe. A long right and left nut takes the ends of the opposite screws, and upon the center of each nut is a ratchet wheel with eight teeth and eight rectangular spaces between them. Close to the face of each ratchet wheel is a sliding piece, each piece carrying two straight pawls which face in opposite directions, one pawl being employed to screw up the right and left nut, or to apply the friction pressure, and the other pawl being used to unscrew the same nut. These pawls have a space between them in the direction of the axis of the shaft, sufficient to allow either of them to be carried back and forth far enough to move the ratchet one tooth at a time without bringing the other pawl into contact with the ratchet wheel. When it is necessary to move the right and left nut more than one tooth of the ratchet, and when the pawl returns to take hold of the next tooth, the small fine-toothed ratchet wheels on the ends of the nuts come into play. These ratchets have teeth which face alike each way, 45 degrees from the radial line, and with light pawls dropping into them, offer sufficient resistance to prevent the nuts from turning in either direction.

When it is necessary to turn the nuts in the other direction, or, say, to unscrew them instead of screwing them up, the other operating pawls are brought along to engage with the ratchet wheels. The slides thus move the same distance back and forth as when the screwing-up pawls are in action, but the movement is so much farther along the shaft.

These two movements of the pawl slides are accomplished by the double-forked levers in connection with the double crank which operates them. These forks and the crank shaft are mounted on a sleeve in which the shaft turns freely, and which is held up against the friction arm hub by a collar at the outer end of the sleeve. The crank shaft being turned to the left, as indicated by the arrow, the crank pins work against the left side of the fork and down into the left opening of the fork; but when the crank shaft is turned to the right, the crank pins will work against the right-hand side of the fork and down into the right-hand opening of it. The effect will be that when the crank shaft is turned to the left, the forked lever will vibrate from the vertical position entirely to the right of that position; and when the shaft is turned to the right, the forked lever will vibrate from the vertical position entirely to the left of that position. Thus, whether the shaft is turned continuously to the right or to the left, the pawl-carrying slides will move back and forth the same distance; but in one case the screwing-up pawls will be brought into play, and in the other case the unscrewing pawls will operate. The movement is an ingenious one, and apparently, quite satisfactory for the purpose intended.

The clutch is made by the Gemlo Iron Works, Minneapolis, Minn.



A NOVEL FRICTION CLUTCH.

Death of Gen. Joseph T. Torrence.

General Torrence, who died in Chicago on October 31st, seems to have had what would be considered a remarkably successful career. He was born in Pennsylvania in 1843. Early in life he was employed in the blast furnaces at Sharpsburg in that State. He learned the blacksmith trade, and at the age of seventeen had become assistant foreman. He enlisted as a private in an Ohio regiment, was severely wounded and honorably discharged. The next five years he spent in the service of some of the Pennsylvania furnace owners. In 1869 he went to Chicago and took charge of the furnace of the Chicago Iron Works, and the next year became connected with the Joliet Iron & Steel Company. In 1881, with Joseph H. Brown, of Youngstown, O., and some others, he organized the Joseph H. Brown Iron & Steel Company. The works were bought by the Calumet Iron & Steel Works, General Torrence being retained as consulting engineer. He later organized the Calumet & Chicago Terminal Railway Company, to build a railroad around Chicago to facilitate the transfer of east and west bound freight. He was also interested in many other similar enterprises, and last year retired from active business with a fortune estimated at $10,000,000.

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The use of hollow shafts for stationary engines is making progress in this country. The Bethlehem Iron Company are to supply twelve of these shafts for use in the various street railway power plants of Chicago.

ELECTRICAL MACHINERY.

Negative Efficiency.

BY F. A. HALSEY.

The efficiency of any power-transmitting machine is the ratio of the power delivered, or output, divided by the power absorbed, or input. Many have never thought further on the subject than to suppose that this ratio must be somewhere between zero and one, zero representing a loss of all the input, and one representing no loss.

In point of fact, a machine may have an efficiency less than zero, that is, the efficiency may be negative, and there is no limit to the numerical value of negative efficiency, which may even be negative infinity. The contemplation of this subject is instructive, as it leads to clearer views; and as this aspect is not widely understood, a little space devoted to it will not be wasted.

Any self-sustaining hoisting machine may have a negative efficiency during the lowering of the load, and this negative efficiency increases in value indefinitely as the load is reduced, and for a load of zero it becomes infinite. While this statement is true of any self-sustaining hoist, the electric elevator furnishes, perhaps, the best illustration of it, because the work of the descending load is made to generate current which may be and is turned to useful account.

In the sketch, the figures on the horizontal line represent pounds of net load, and the verticals to the line $O\,a$ represent the foot-pounds of work actually used in hoisting these loads. The weight of the car and its counterweight cause some friction to the machine, even when there is no useful load, and in consequence $O\,O'$ foot-pounds are required to lift the empty machine. Similarly, the verticals from $O\,X$ to $O'\,b$ represent the work of driving the loaded machine with various loads. The frictional and other losses for any load are represented by the portion of the vertical line for that load lying between the lines $O\,a$ and $O'\,b$. That is, while the verticals to $O\,a$ represent the useful effect, or output, those to $O'\,b$ represent the power applied, or input, and the ratio between the lengths of the two lines from $O\,X$ to $O\,a$ and $O'\,b$ for a given load is the efficiency for that load.

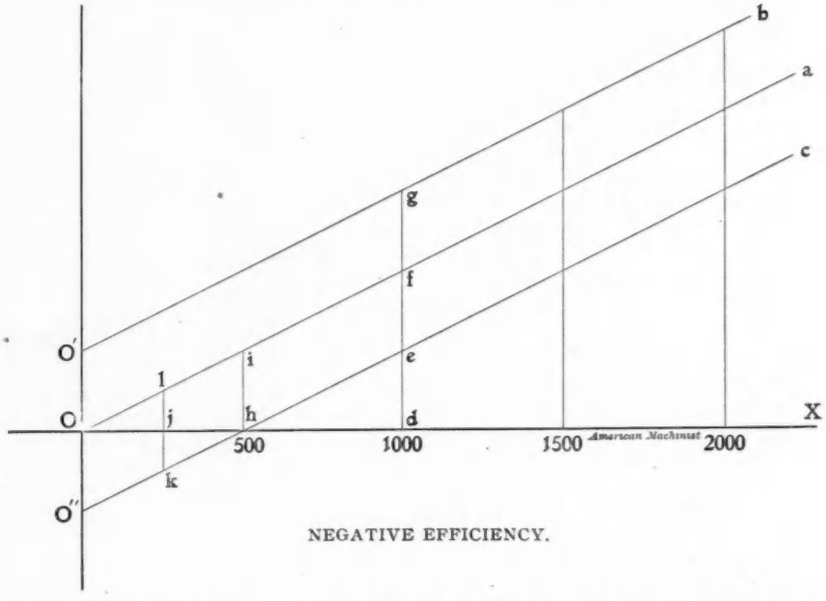
During the descent of the load it becomes the source of power, and the power developed by the load during the descent is represented by the length of the verticals to the same line $O\,a$. If the load be heavy enough, it will drive the machine, and, converting the motor into a dynamo, will generate useful current.

Since the descending load furnishes the power, the losses must be subtracted from it to obtain the output of current. Doing this, we obtain the line O'' c, verticals to which from $O\,X$ give the foot-pounds of output, and, just as before, the ratio of the output divided by the input, that is the length of the lines to $O''\ c$ divided by those to $O\ a$ gives the efficiency during the lowering of the load. That is, taking the lines for a load of 1,000 pounds,

$$\frac{d\,f}{d\,g} = \text{efficiency for hoisting;}$$

$$\frac{d\,l}{d\,e} = \text{efficiency for lowering.}$$

Now suppose that the point where the load is no longer able to drive the machine and generate current is at 500 pounds load. At this point the efficiency, when lowering, becomes $\frac{0}{h\,i} = 0$; that is, the work of the descending load is all absorbed by friction. If the load be less than 500 pounds, current must be supplied to the machine to drive it as a motor and help the load to run down, making a case of input at both ends. What was formerly output of current has become



NEGATIVE EFFICIENCY.

input, or negative output, and at, say, 250 pounds load the efficiency is $\frac{-j\,k}{j\,l}$, which is negative. If the load be still further reduced, the numerical value of the numerator increases, while that of the denominator decreases, and with a load of zero the efficiency becomes $\frac{-O\,O''}{0}$ = negative infinity.

It will be seen that this value does not mean that an excessive current is being used. On the contrary, $O\,O''$ is equal to $O\,O'$, as both $O\,O'$ and $O\,O''$ represent the power required to turn the idle machine; $O\,O'$ in one direction and $O\,O''$ in the other. It will be seen also that the reason for the surprising result of infinite negative efficiency lies in considering the load as the source of power during the descent. With a load less than 500 pounds, both load and current are really sources of power; and for this part of the scale, considered by itself, there is, at first sight, no reason why one should be so considered more than the other. Were the current considered the source, the efficiency at 250 pounds load would be $\frac{j\,l}{-j\,k}$, which is still negative; but we note that as the load is reduced it is now the numerator which grows smaller, and with no load the efficiency becomes $\frac{0}{-O\,O''} = 0$, the same as when hoisting a load of zero.

Further reflection will show, however, that this it not the most rational way of looking at the case. With the load above 500 pounds and generating current, there is no doubt that it is the load which is the source of power, and there is no reason why a change should be made and the current be considered the source at the point where the load no longer generates. Moreover, if we consider the current the source during the descent, we find a still more peculiar condition of things at 500 pounds of load. Thus, considering the current the source, the efficiency at 250 pounds is $\frac{j\,l}{-j\,k}$, which is still negative as before. As the load increases toward 500 pounds, the numerical value of the denominator decreases, as the previous fraction did when the load approached zero, and the numerical value of the negative efficiency increases indefinitely. The sign of this efficiency is now, however, determined by the denominator; and while it continues negative as long as the denominator has any value, it loses its sign when the denominator becomes zero, since, in the nature of things, zero can be neither positive nor negative. At 500 pounds load, then, the efficiency becomes either positive or negative infinity, the former of which is clearly unthinkable, while the latter is equally so, since we have a de-

scending load driving the machine, but producing no output; and the only rational view of the value of the efficiency at this point is that it is zero, which is the result obtained by considering the descending load the source of power.

Viewed from all points, then, the load during the descent must be considered as the source of power, and the possible range of efficiency in machines must be set down to be from minus infinity to plus one.

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The Transmission of Power by Electricity and by Gas.

The recent inaugural address of Dr. Louis Duncan, President of the American Institute of Electrical Engineers, presented a résumé of the subject of transmission of electrical energy. The discussion of the address called out the following remarks by Mr. N. W. Perry, which are of general interest at the present time, when this subject is receiving so much attention. It does not appear how much or if any allowance for leakage was made in Mr. Perry's calculations, which one of the participants in the discussion thought might be a serious item. When the results obtained with long pipe lines carrying compressed air are considered, and especially when the trifling pressures proposed with gas and compared with those habitually used with air, it does not seem that this question of leakage can be a very serious one. We are acquainted with a mining plant of compressed-air machinery, in which the pipe lines aggregate twenty miles in length, and in which tests show that the leakage aggregates 10 per cent. of the total air supplied. The air is, of course, at service pressure for power purposes, and the pipe lines are, naturally, of great complexity and under conditions far less favorable to maintaining tightness than would be the case with distributing mains for gas:

"The question of distribution of energy in municipalities, that is, short distribution, as distinguished from transmission of energy over long distances, presents quite a different problem. The two cases are entirely different and distinct. For instance, we find that in long-distance transmission of energy, the transmission of that energy in the potential form is usually the cheaper way. I think, Mr. President, you said in one of your former papers that the transmission of coal was effected to-day at about half-a-cent per ton-mile. Now, we find in our large cities that while we have got our coal to the depot or to the water front at a cost of, say, half-a-cent per ton-mile, we are paying fifty cents, perhaps, per ton mile to get it from the water front to our central station. It costs fifty-seven cents a ton to deliver coal on the sidewalk outside the Duane street station of the Edison Electric Illuminating Company, of New York, and to carry away the ashes, and that is a distance of perhaps a mile and a half, not more than two miles, from the water front. Now, in respect to distribution in a large city, it is necessary with our low potential system, of course, to locate our central station in the center of the district to be supplied where real estate is high. That means that our fixed charges are large, and one of the largest charges in the cost of our energy is the fixed charges. It becomes necessary, then, that we should reduce those fixed charges to the lowest possible amount. With our present methods I believe it is fair to assume that the boiler room occupies about the same space as the dynamo and engine room do; that is, they are about half-and-half. The gas engine is a recourse which I have advocated. It would do away with the boiler room, which takes fifty per cent. of the floor space. It would require a little more attendance perhaps than the steam engine, but the stand-by losses would be reduced, and it would permit the location of our plants on property which was cheap and where fuel could be had with the minimum of handling. I recently had occasion to make a few calculations as to the cost of distribution of energy in the potential form of gas. Assuming a gas of .55 specific gravity and with a calorific power such that 25 cubic feet consumed in a gas engine per hour would give a horse-power hour under fair conditions, I got some results which astonished me, and which will doubtless astonish others who have not looked into the matter. Assuming a transmission to a distance of 5,000 yards, gas of a specific gravity of .55, and a pipe 12 inches in diameter, and, to provide for bends, that there was a 90-degree bend every 200 yards, I have figured out the percentage of power consumed in the transmission under various degrees of water pressure. Under 1 inch of water pressure we would transmit 500 horse-power of such a gas; the percentage of the power transmitted consumed in transmission would be .007 of 1 per cent. Then going to 10 inches of pressure, we would deliver 1,600 horse-power with a loss in energy of transmission of .07 of 1 per cent. of the power delivered. The percentage loss in transmission with gas is very nearly directly proportional to the pressure, whereas you know that with electricity it is the other way, and the two curves would cross each other somewhere —just where would depend upon the conditions. While the gas transmission for municipal distribution would seem to be by far the more economical method, it would not apply at all to the longer transmission, because of the direction of these two curves, which would be straight lines approaching each other at a somewhat obtuse angle. The plan which I had in mind was the location of a large plant for commercial purposes on land which was cheap, on the water front or on a railroad where the coal could be handled at a minimum of expense, and the ashes be gotten rid of with very little trouble, and the transmission of that fuel gas to centers of distribution where gas engines would be employed to drive dynamos. Those centers would preferably be centers of smaller radii than usually supplied by central stations; or if for any reason it seemed desirable to increase the radius of these districts, and even with the shorter ones, it might be advisable, as President Duncan has said, to use the storage battery in order to use the machinery and plant and labor that we did employ to their best output. But it seemed to me that these figures of the cost of transmission, the drop in transmission by gas, is something that is astonishing. I had no idea that I would arrive at any such figures as those when I started to bring out these figures. In electrical transmission, when the distance is not very long, we allow 10 per cent. Five per cent. would not be economical in many cases, and here we go down, in one case, to the seven-thousandth part of 1 per cent."

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Erratum.

In the electrical power tests which were published in our issue of September 24th, an error occurs in one of the tests. In the vertical boring and turning mill tests which appear at the bottom of the first column on page 902, the heading should have read "boring cast-steel driver hub," not "boring cast-steel driver tire." The speed given is obviously impossible for the diameter involved in boring the tire.

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A workman who was knocked senseless by an electric shock at the foundry of the Anaconda Copper Mining Company, was resuscitated, after the usual expedients had failed, by removing his clothes, burying him in the foundry sand, except his mouth and nose, and thoroughly soaking the sand with a jet of water. The same experience strangely enough happened to the same man twice.

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The electric motor switch cars for the Brooklyn Bridge are expected to be in service very shortly. These cars run with the trains, but their motor equipment is for switching purposes only, the haul across the bridge being continued as at present. In other words, the electric motors will perform the service of the present separate switch engines. The bridge service offers an unusually favorable set of conditions for cable traction, and there is little likelihood of its being displaced. The security against collisions, due to the cars being secured to the cable, as well as the balancing of the cars going up hill by those going down, are features of cable traction which no other system offers.

Letters from Practical Men.

A New Kink With a Reamer.

Editor American Machinist:

I write partly for the purpose of thanking your correspondent, Francis W. Clough, for his expressed appreciation of my remarks in regard to reamers, and partly for the purpose of sending an additional kink relative to this subject, which may be of value to your readers generally.

The cutting edges of the reamers which we find in the tool store are usually ground sharp, and quickly lose their size by use. I am inclined to think that the manufacturers purposely make them a trifle large; say one or two thousandths. If the new reamer is exact to size, as it should be, it should also be in condition to maintain its size after considerable use. With the sharp-edged tooth this is not possible. Suppose such a reamer to be two or three thousandths large; then all that is needed to bring it into good condition and exact to size, is to take a cast-iron collar having in it a hole of the required size, and after applying a small quantity of Arkansas stone powder and oil to the inside of the hole, passing it over the reamer just as you would if you intended to ream; only turning backward instead of the usual way. This must be slowly and carefully done by hand. One pass-over will in all probability be sufficient.

This to me is an entirely new kink. I have had but one opportunity to try it; but the result was so surprisingly satisfactory in this instance that I feel sure it will prove the same in others; that is, if the conditions are similar. With a reamer treated in this way we have triple advantages; viz., correct size, the cutting edge in much better condition to maintain the size, and—what will please our friend Clough—a reamer that will not chatter. Should any of your readers be tempted to take their chances by putting this idea into practice, they will confer a favor on your correspondent by stating results in your valuable paper.

T. R. Almond.

Brooklyn, N. Y.

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Roller Bearings.

Editor American Machinist:

I am led by a recent article in the "American Machinist," on the increasing use of roller and ball bearings, to give my experience in their use.

The bearings in question were applied to a certain line of wheat machinery, in which the wheat was passed between rolls which necessarily exerted considerable pressure. The power required for driving was excessive and the heating of the journals very troublesome, until roller bearings were introduced which greatly reduced the heating and diminished the driving load at least one-half, and, I believe, considerably more, although I have not the figures at hand at present.

An extended use of the bearings, however, showed that they required considerable attention. The rolls, which were of hardened steel, were confined in cages according to the usual custom, and in numerous instances two or three rolls in a cage would develop a tendency to work endwise, eating slowly through the soft cage and eventually ruining it. Measurements with micrometer calipers did not show that these rolls varied in diameter from the others, or that they were ground tapering. Evidently, then, the trouble was with their alignment in the cages; but this error was certainly very slight. As this trouble threatened the destruction of over one hundred cages it was food for considerable thought, and by properly protecting the ends of the cages the difficulty can probably be overcome.

Another point brought out was that the bearings must be kept scrupulously clean, for soft materials will soon gum up the cages, while gritty substances will soon destroy them. The journals of the rolls to which these cages were applied were, of course, hardened; yet on removing a roll one day for inspection, a rut was found $\frac{1}{16}$ inch deep, extending all round the journal and of the same length as the rolls, which, curiously enough, were as bright as ever. Some gritty material had evidently found its way within and had attacked the softer metal. The friction of the roll with one of its journals in such a condition was probably very excessive; but this is the worst case that has come to my notice.

I think that it is now generally acknowledged that, for high pressures, rolls are superior to balls in anti-friction bearings, and this has been my experience. At one time ball bearings were introduced, the balls being confined in rows in cages and running on extra hard steel bushings, as is necessary in such a case. These cages failed in a few days, the balls and bushings cracking.

Speaking generally, I should say that with high pressures such as are set up between rolls of almost any kind, roller bearings effect an enormous saving in power, but require constant attention to reduce cost of repairs, which in the present state of the business is considerable.

The worst trouble with roller and ball bearings is that when they fail they fail suddenly and chew up everything within their reach. A gentleman of undoubted veracity once told me that in a certain Western city he had seen a horse car—it was in the days of the horse—equipped with roller bearings, which he could push on a level track with one finger. The trouble with the invention was that the bearings went to pieces suddenly and disastrously.

In justice to the roller bearings, however, I would say that in the shops of the Brown & Sharpe Manufacturing Company I have seen a sheet-metal rolling mill whose journals run in roller bearings, and I am told that no trouble is experienced with the cages. Simply as a guess, I should say that these journals were 3 inches in diameter, while my experience has been with journals of about one-half that size.

William H. Morse, Jr.

Worcester, Mass.

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Flow of Water in Pipes.

Editor American Machinist:

While your answer (185) in October 22d number of the "Machinist" to the question "How many pipes of a smaller diameter will it take to give the same volume under same head as a pipe of larger diameter?" is perfectly correct, it would have been more widely useful had you given the general law applicable to such questions. This law is, that the discharging capacities of long pipes (*i. e.*, pipes of not less than 1000 diameters in length), of different diameters, other things being equal, are as the square roots of the fifth powers of the diameters. Thus, if d = the diameter of one pipe, and d' = that of another, and q and q' their respective deliveries, the lengths and heads being equal, we have:

$$\frac{q'}{q} = \frac{\sqrt{d'^5}}{\sqrt{d^5}} \qquad (1)$$

or, to simplify the calculation when logarithms are not used:

$$\frac{q'}{q} = \frac{d'^2\sqrt{d'}}{d^2\sqrt{d}} \qquad (2)$$

To take your example of how many pipes 5 inches in diameter are required to replace one of 10 inches, other things being equal, we have:

$$\frac{10 \times 10 \times \sqrt{10}}{5 \times 5 \times \sqrt{5}} = 5.6$$

The following formula is exceedingly useful, as it gives at a glance all the relations between pipes of different diameters, lengths, heads and quantities discharged. Let d, l, h and q represent, respectively, these elements of one pipe, and d', l', h' and q' those of another. Then

$$\frac{d'^5 \times h' \times q^2 \times l}{d^5 \times h \times q'^2 \times l'} = 1 \qquad (3)$$

To show the utility of this formula, let us apply it to the solution of the second part of the same question, and suppose that it was desired to know what increased head should be given to 5 pipes 5" diameter, to give an equal discharge to one of 10". Each of the smaller pipes must discharge $\frac{1}{5}$ or 0.20 of the larger pipe. Making q = unity in the above, and the lengths l and l' being equal, we have:

$$h' = \frac{(10)^5 \times (0.20)^2}{5^5} h = 1.28\, h$$

There would be, in a very fine calculation, a trifling correction to apply, due to

the different co-efficients corresponding to the different diameters, but in practical cases this can be safely ignored.

If to the above equations you add the following, your readers will have a complete system of long pipe hydraulics.

$$D = \sqrt[5]{\frac{Q^2}{H}} \quad (4)$$

$$Q = D^2 \sqrt{D \times H} \quad (5)$$

In which D = diam. in ft., Q = quantity discharged in cu. ft. per second and H = fall or head per 1000. This is for very rough cast iron pipes of not less than 1000 diameters in length. For very smooth ones we have:

$$D = 0.87 \sqrt[5]{\frac{Q^2}{H}} \quad (6)$$

$$Q = 1.41\ D^2 \sqrt{D \times H} \quad (7)$$

E. SHERMAN GOULD.

Scranton, Pa.

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Box Tools for Turret Machine.

Editor American Machinist:

I have seen very little matter of late in your valuable paper relating to the subject of turret-lathe tools, as applied to the rapid manufacture of small parts, such as bicycle-bearing cones, cases, swing-machine parts; and more especially in brass work, steam pump, engine and locomotive fittings, etc., oiling devices, screw valves, inspirators, injectors, various forms of plain oil cups, etc., such brass work being as play to the modern turret lathe fitted with properly designed tools for the special product to be made.

I received the inspiration for agitating this subject from a recent visit to the plant of a large monitor lathe maker. My attention was called to a machine of the regular style, fitted complete with tools for screw-valve work; the fact became at once apparent to me that there was a great over-abundance of tools for the machining of each piece.

Referring to the cross-section sketch, Fig. 1, of a globe valve body (about 1½ inches, of the ordinary type) *a, b, c, d, e, f* and *g* are the parts to be finished. For the center piece, end and seat four separate tools and a tap were made: No. 1 tool rough-cut *b* and centered *d* and *g;* second tool rough-cut *c, d* and *g;* tool 3 finished *b c d* and *f*, with *g* for a guide; fourth tool cutting the clearance *e* for seat *f* and turning off *a*, with *d* for a guide, thereby using five of the six holes in the turret. Other parts of the valve were supplied with tools in proportion, the whole making a kit that would fill the spare room in the average tool-room, and cause the manufacturer who ordered it to shed salt tears when he looked over the bill.

Following, in Fig. 2, I attempted to show the placing of seven tools, ¼ x ⅜ inch, in a holder of machine steel (tools held in place by clamps and screws *A A, B B*), to cut at one operation all the parts; *a, b, c, d, e, f* and *g* being the cutters for the corresponding parts in Fig. 1.

Fig. 3 illustrates a finishing tool for seats *b* and *f; bb* and *ff* are cutters inserted in shank of machine steel, by milling cross slots, half the thickness of the cutter, below the center. The cutters are held in place by screws as shown; *gg* and *dd* being guides to fit *g* and *d* in Fig 1.

I am of the opinion that there is a wide field of discussion open for some of the intelligent tool-makers on the above subject.

D. E. MACCARTHY.

Detroit, Mich.

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Planer Speeds.

Editor American Machinist:

Mr. Webber's experience in speeding up planers has given me a shock. We have always been taught that the reason why planers of the ordinary construction were not made to return at a higher speed than about 3 to 1, was because they could not be, and most of us know something of the entire reconstruction of the machine which was found necessary by Wm. Sellers & Co. in order to increase the speed of the return.

A return of 3 to 1 means 60 feet return for 20 feet cut, and any increase of one means, of course, a corresponding increase of the other. At bottom, the limiting factor is not one of ratio, but of the speed in feet per minute which can be successfully given to the table. The return speed is usually stated as a ratio, because the cutting speed is fixed; but it is plain that it is really a question of quickly imparting a given velocity to the machine.

If a planer speeded to 30 feet can be returned at 90, I can see no reason why one speeded to 20 cannot also be returned at 90; and, on the other hand, if 60 feet return is the limit for 20 feet cut, I can see no reason why the same return speed is not also the limit for 30 feet cut. In other words, if our planer builders are right in saying that, as usually built, the return speed cannot be successfully increased beyond 60 feet, it seems to me that we are bound to get into trouble when we increase the usual cutting speed of the present style of machine. Whether 60 feet return is or is not the final limit, it is obvious that the principle outlined is sound, and that when the practicable limit of the return speed is found, it will be a fixed limit for all cutting speeds. It follows that the ultimately correct variable-speed planer will have a fixed return speed at this limit, and a variable cutting speed independent of the return.

I was much impressed with a fact brought out in the power tests of the two styles of Sellers planer reported in your first collection from the Baldwin Locomotive Works. The figures showed beyond question that the real absorber of energy in reversing a planer is the pulley system, and not the planer table. I have been making a little calculation on this subject, the results of which have been an eye-opener to me, and I have no doubt they will surprise your readers. The stored energies of two masses of the same weight, moving at different velocities, are to each other as the squares of their respective velocities. Applying this rule to actual

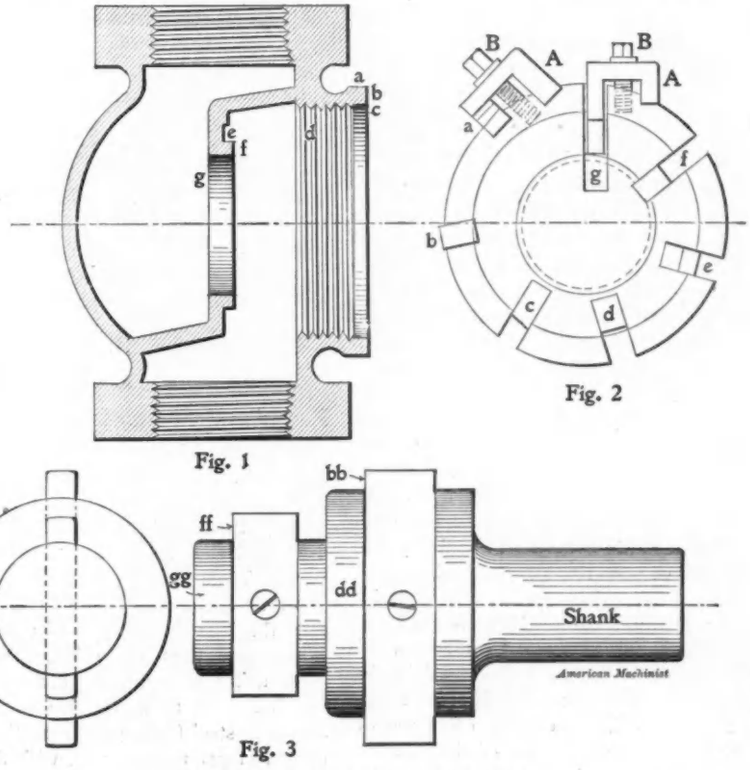

Fig. 1 Fig. 2

Fig. 3

BOX TOOLS FOR VALVE FINISHING.

ratios between the velocities of table and belt, gives some startling results. Two planers which I recently measured up, had ratios between belt and table speeds of 67 to 1 in one case, and 90 to 1 in the other. Squaring these figures gives 4,489 in the first case, and 8,100 in the second. In other words, in stored energy 1 pound of iron in the rim of the belt pulley would be the equivalent of 4,489 pounds in the table in the first machine, and 8,100 pounds in the second.

These figures, of course, ignore the effect of friction, which, by assisting to stop the parts, would, during the stopping, decrease the relative effect of the table, and by opposing the starting, would, during the starting, increase the effect of the table. Without regard to the part played by the friction, the figures are sufficient to show how much smaller is the effect of the table, and how much larger is the effect of the pulleys, than has been supposed.

C. O. GRIFFIN.

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Power and Speed of Machine Tools—Some Lessons from Cotton-Mill Spindles.

Editor American Machinist:

I have read with great interest the letter of my son, Wm. O. Webber, on speed and power of machine tools, and your comments on the same, as well as the previous communications of Tecumseh Swift and others.

I agree with you, that a heavier feed at a lower velocity will produce the same results, so far as production is concerned, as a low feed at a high velocity, and might possibly consume less power; but does not the question come down to this point, the ratio of power to production?

I am reminded by this of a long series of power-weighings in the cotton mills of New England between 1870 and 1880, when the new light spindles used in the spinning frames were introduced. It began in the 60's by cutting off three or four inches from the top of the spindle, and reaming out the bobbin, so as to reduce both weight and vibration. Then the spindle was cut off at both ends, and reduced in diameter, so as to be but about one-third the old weight. Then the bobbin was reamed out at the bottom, and the bearing, or "bolster," carried up into it on a tube, so as to be about in the center of gravity, all these changes reducing the power required, until one-half of it was saved at any given velocity. These changes were carried so far as to produce a reaction, and the weight of the spindle has since been increased, so that it is now usually about one-half the weight of the old style, instead of one-third.

Now, the late Geo. Draper, of Hopedale, Mass., who was active in introducing these light spindles, on their merit as savers of power, soon saw the business point of view to be taken. He said: "Although these spindles will save half the power at the old speeds, there is much less vibration in them, and they can be run very much faster, is it not economy to drive up the speed and increase the production, at the same cost, for labor, power and general expenses, rather than to save part of the cost of power, which, at most, is but a small proportionate item?"

The mill owners saw the point, and the result is that spindles are now running from eight thousand to ten thousand revolutions per minute where they formerly ran from five thousand to six thousand, with about the same consumption of power and a great diminution in cost of production, the other expenses remaining practically the same, daily or annually, while the weight of yarn per spindle has been increased from one-third to one-half.

Now the same general law will apply to tools for working iron as to machines for spinning cotton, and it has occurred to me that these data might interest some of your readers while the question of power is under discussion.

As I have said, the important question is—How much power is required to obtain a certain product, without reference to the intrinsic power absorbed by the machine? on which point some of the tests you have published have given valuable information.

SAM'L WEBBER.

Charlestown, N. H.

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Power and Speed of Machine Tools—Good Steel.

Editor American Machinist:

We, as well as Mr. Webber, have been greatly interested in reading Tecumseh Swift's letter regarding "Power Tests versus Time Tests of Machine Tools." We fully agree with both of these gentlemen that the time test is of vastly more importance than the other. We have been using a tool steel for some time which enables us to rough wrought iron and mild-steel forgings at a cutting speed of 30 feet per minute, and, with the same steel, find no difficulty in roughing cast iron at from 35 to 40 feet per minute. Our experience also points to the same fact mentioned by Mr. Webber, that the work is more accurate at these high speeds than was obtained at the lower cutting speeds.

BUCKEYE ENGINE CO.,
Per C. S. Bonsall.

Salem, O.

▲ ▲ ▲

Power and Speed of Machine Tools—Speed of a Planer.

Editor American Machinist:

Mr. Wm. O. Webber's article on planer practice was a very interesting one, but he omitted the most important data, viz., class of work, length and depth of cut, width of feed and quality of iron.

I have not the least doubt that a planer platen many be jerked back and forth at the rate of 30 and 90 feet; but I do doubt that much stock could be removed at one cut with cast-steel tools, without over heating the tool and thus destroying its immediate usefulness. How many square inches of surface were planed per minute by these high-speed planers?

I have seen 10-pitch rack, 1 inch wide and in 12-inch lengths, cut (?) at the rate of 10 feet per hour on a planer running 20 feet per minute; and had the job been a piece-work one, I do not think the planer hand would have clamored for more speed.

I have done some planing at the rate of 18 feet per minute, with a roughing cut of ½-inch feed, and the finishing cut 2¼ inch feed, and actually think I finished more surface than would have been possible with a platen speed of 30 feet.

F. L. JOHNSON.

Lynn, Mass.

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A Machinist's Spirit Level.

Editor American Machinist:

I notice in one of your recent issues a paragraph which says, "Some machinists are much given to the use of the spirit level in setting work," and suggests that it would be amusing to see an attempt to use it on board a ship.

It is fortunate enough that the level may be dispensed with in setting work, yet I am one of those machinists who place a high estimate on its usefulness, especially where work on a planer or shaper must be chucked in a vise; for it is rarely, if ever, that these attachments are made sufficiently strong not to spring when the holding strain is put upon them.

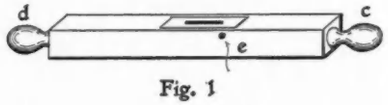

Fig. 1

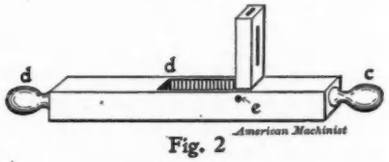

Fig. 2

HOME-MADE LEVEL.

Owing to the great variety of work that comes to a shaper in a general machine shop, I have found that a vertical position is as often to be secured as is that of a horizontal, in chucking work; and on account of the clumsiness of the ordinary combination level, I decided to construct one having a more convenient form. Its construction and manipulation being so simple, I have thought that toolmakers might be interested in seeing it; hence the inclosed sketch, which may serve this purpose.

A piece of ¾-inch square machinery steel, 8 inches long, was used. It will be seen that the drop-case is pivoted at *e*, and at *d* a holding snap is provided which connects to the handle *a*, a slight pull of which detaches this case, and by means

of an underlying spring it is raised to the position shown in Fig. 2. A small screw is placed directly underneath the drop-case for the purpose of adjusting the level to a truly vertical position. The handle at *c* is simply for the sake of uniformity in appearance.

The advantages to be gained from this level may not at first sight become apparent; but its small size, ¾ x ¾ inch, often enables its use between the tool-holder and the work, where a more bulky instrument could not be placed. Then, work having a rough surface frequently requires length in a level in order that it may be generally true.

Where a chuck may be arranged to receive work of uniform shape and size, the level may undoubtedly be dispensed with; but where the variety is next to endless, I consider the level indispensable, or, to say the least, its use will greatly facilitate the work.

QUIRK.

▲ ▲ ▲

The Outlook for American Machinery in China and Japan.

Quietly, but none the less effectually, a most portentous revolution is working out in China, and incalculable as the results must be, the opportunities offered to American enterprise are such as to demand immediate attention. Chinese conservatism and hatred of innovations have received a telling blow from the unexpected victories of Japanese arms in the late war, and two passions are stirring up the reactionary proclivities of the Mandarins: First, a deep and intense hatred for the despised "wo jin," or pigmies, as they call their late enemies; and second, a strong fear of the possible dismemberment of China. They understand now that the time for obstructing the march of progress is past, and that their very existence depends upon the admittance of our engines of civilization. So Li Hung Chang has made a tour of the world; he has seen with his own eyes the results of our civilization, and word has gone forth from Peking that obsolete ways and means must vanish to be replaced by modern machinery and manners.

Ever since the peace of Shimonoseki, immense activity has prevailed in the open ports of China, and notably in Shanghai. Of this revival the Japanese were the direct cause. While the negotiations between Li Hung Chang and Ito were in progress, the latter feared the opposition of Great Britain to Japan's acquisition of the Liao Tung Peninsula, and to propitiate that mercantile power, he insisted upon the insertion of the following three clauses, viz.:

1st. The opening of five new ports;

2d. The privilege of manufacturing by Japanese subjects in the open ports of China; and

3d. The abolition of the li-kin duty.

As to the first, nothing need be said, except that the opening of every new port adds to the trade with China; but as these new ports are in reality for the export of beans and other edibles necessary for over-crowded Japan, the benefit to foreign merchants was merely nominal; but:

By the second clause above-mentioned a new era was inaugurated in the Middle Kingdom. Hitherto the right of manufacturing in China had been reserved to the Mandarins, and Li Hung Chang, Viceroy of Pechili, as well as Chang Chih Tung, Viceroy of the two Kiangs, owe not a little of their immense wealth to the modern cotton factories and silk filatures owned by them, but managed by foreigners. They had guarded this privilege with the greatest jealously, and neither foreigner nor native was allowed to enter into competition. But the treaty with Japan was signed, and, as in the so-called "favored nation" clause of China's treaties with other nations, it is stipulated that "no privilege shall be granted to any nation which is not shared by all alike," this stroke of the pen opened China to steam-whistle and wheel. Consider what this means: Unlimited labor at the smallest of wages, amounting to less than 50 per cent. of those paid in Japan; virgin fields of anthracite coal, now selling at $3.75 Mexican, or $1.87½ per ton delivered in Shanghai; transportation at a mere nominal cost, owing to the intense competition of any number of steamship companies; and last, not least, a *constant* tariff, almost immutable, of five per cent. *ad valorem*.

Under these circumstances it is not astonishing that companies were formed at once to start mill and factory. The American Trading Company, of this city, inaugurated the movement with a cotton mill factory, capitalized at 1,000,000 taels (about $730,000 gold). Messrs. Jardine, Matheson & Co. followed, and since that time Shanghai has changed from a purely mercantile community into a stirring manufacturing city.

Of course, this is only a beginning. But consider the opportunities hereby offered to the American manufacturer of machinery. There is no longer any doubt that he can compete with the English. American machinery has so often carried off the medal in international exhibitions, and American ingenuity is so well known, that all he needs is to make an effort to open this new and unlimited market. And there is one great advantage he possesses over his European competitor, viz., the saving in time and cost of transportation.

There are at the present time six steamship lines plying between the Pacific Coast and China, calling at the Japanese ports of Yokohama, Kobe and Nagasaki: The Pacific Mail and O. & O. (Southern Pacific) companies run seven steamers from San Francisco; Samuel Samuel & Co. have three from Portland, Ore.; the Northern Pacific Company has four from Tacoma, Wash.; the Nippon Yusem Kaisha plies with three from Seattle, Wash., connecting with the Great Northern Railroad, and the Canadian Pacific has the three boats of the Empress line from Vancouver, B. C. The time is from 17 to 19 days between New York and Yokohama, or from 22 to 24 to Shanghai. Raw cotton is now carried from New Orleans overland to San Francisco, shipped to Yokohama by steamer, and transshipped there to Osaka, where it is laid down at 60 cents a cwt. Two steamship lines sail from New York direct to Yokohama via the Suez Canal, and calling at Shanghai, viz., the Perry line and the Barber line. These steamers carry freight at from $5.50 per ton up.

And now I must refer to the abolition of the li-kin duty, which is as important to our manufacturers as the privilege of manufacturing. The import duty into China, as stated before, is 5 per cent. *ad valorem*, but the Mandarins had appropriated the right to collect a toll upon all merchandise passing through their territories. This toll, called "li-kin," by the frequency with which it was levied, acted in reality as a prohibitory tariff upon foreign goods in the interior of China, so that the consumption of our manufactures was confined to the coast and territory immediately adjacent to it. The abolition of this toll has opened the interior of China, and within the past year, importations have increased at an incredible rate. Hankow, four hundred miles up the Yang-tse River ("Kiang" means "river"), is rapidly becoming a manufacturing city. It is there that the railroad shops are located, and machinery of all kinds is in demand. The Baldwin Locomotive Works, of Philadelphia, Pa., has a very active representative in the field in the person of Capt. W. H. Crawford. That gentleman within a few years has sold 120 locomotives to the Japanese, and has recently received the contract for eight from the Chinese Government. As all contracts means *cash*, the market is exceedingly profitable, and other American manufacturers will do well to turn their attention to this field.

R. VAN BERGEN.

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It is reported that since the Johnson Works moved from Johnstown, Pa., to Lorain, O., with the object of securing transportation for ore and finished product by water instead of by railroad, the railroads have practically boycotted the product of that concern, thus showing that they would prefer that such establishments should remain in Pittsburg, or in localities where their operations will necessarily involve haulage by railways, regardless of economic advantages.

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The Liverpool Overhead Electric Railway has been extended for the second time in its history. The total length of the line is now about seven miles.

American Machinist.

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Space in advertising pages only is for sale.

We invite correspondence on subjects pertaining to machinery.

Name and address must always be given, though not necessarily published.

Communications for or relating to the reading columns should be addressed to the Editor. All business communications should be addressed to the Company.

Subscribers can have their mailing address changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrapper denotes week with which subscription expires.

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The Protection of Publicity.

Letters patent for inventions are in many respects peculiar. A full understanding of them and of their relations can never be a simple task. How best to secure to inventors their property in their inventions must always present some perplexing features. In some cases it may be simple enough, but in some other cases it would seem to be simply impossible. There are, for instance, constantly arising little inventions that are really valuable, but which it is almost impossible to hold, whether covered by a patent or not. They may be so obviously good, so easy of adoption, often, also, so easy of concealment, as in some interior detail of a machine, that they may be widely used without even the knowledge of the inventor, and if he did happen to get upon the track of them he would not be able to recover enough from each individual case of infringement or appropriation to render the pursuit remunerative.

And yet there are inventors and patentees of this class of inventions who consider the official publication of the patents when issued as a great misfortune, if not a great wrong. We noticed in a recent issue of the "Patent Office Gazette" a simple device for a certain purpose, and which struck us as a particularly good one, and as the knowledge of it was already public property we proposed to bring it to the attention of our readers, as we do with other things of interest and value. We had noticed that the patent was issued in the name of an individual as assignor to a manufacturing firm. We wrote to the firm announcing our desire to call attention to the invention, and inviting any suggestion they might wish to offer regarding the mode of presentation. We received no reply, and after a reasonable delay we wrote the individual patentee without succeeding any better. It may be that silence gives consent, but we understood it to mean rather a reluctance to have the invention known by the general mechanical public.

Now, it seems to us that this indicates a rather mistaken way of handling such a patent. To us it would seem that the wider the publication the greater the security and value of the patent. In doing what we could to diffuse a knowledge of it, we should consider that we were doing the inventor a service, as well as the balance of our readers. Many men would steal if they could surely escape detection, who would hesitate long before doing it if detection were more than probable. A man might slip into a machine that he was building a neat little device if no one around him, or if none of his customers, knew that it was already patented by someone else, while he certainly would not use the same thing if it was widely known that it was the property of another, except by arrangement with the owner.

While a wide knowledge that a good device is patented must surely be a greater protection to it than the non-existence of such knowledge, that knowledge would also promote the reputation of the firm or individual most interested. The presumption would be, that where one strikingly good feature originated, others would also be found, and especially if the idea was held in a generous rather than in a miserly fashion. By all means let the public know as widely as possible, if you have a good thing, that you have it, that it belongs to you, that you are not ashamed of it, that you are not afraid everyone will steal it, and that whether they do or not you will still be ahead in the use of it.

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Now for Work and Business.

The American people have again rendered their decision on public questions, and at the present writing the results of the Election seems to be such that the party which will come into power on the 4th of next March will have control, not only of the Executive Department, but also of both branches of Congress.

This we consider to be fortunate. Past experience has, we think, shown that it is decidedly better that an administration should have unhampered opportunity for enacting and executing such laws as are in accordance with the expressed will of the majority of voters. Only thus can responsibility be definitely and clearly placed, and a clear issue formed for decision at the next Election.

As to the effects upon our industrial development, of this last appeal to the judgment of our citizenship, it seems clear that the immediate effect will be beneficial. A vast majority of those who have most to do with influencing and guiding our commercial and industrial affairs, have been on the side of conservatism in this contest, and have believed that the firm establishment of the gold standard of value is vitally necessary to continued progress in commercial and industrial development. The decisive victory for that standard will, as a matter of course, cause a betterment of financial conditions by the encouragement it gives these men, independent of the real importance and the ultimate effect of the step we have taken, or, rather, refused to take.

We may therefore confidently expect an improvement in business for a time, and in fact we now have it; but we can only hope that this improvement will be permanent. If it is true, as many claim it is, that the decision recently rendered is adverse to the interests of farmers and those who perform manual labor, then prosperity cannot continue as a result of the election, because there certainly can be no general or permanent prosperity here unless the classes named are able to maintain themselves in comfort and have a surplus with which to purchase things not absolutely necessary for continued existence. Time only will clearly demonstrate the facts so that all may see and understand.

Above all we congratulate ourselves and our fellow-citizens upon our escape from the dangers which threatened us from a close or an indeterminate result. No campaign within our memory has been attended with so much bitterness, so much senseless recrimination and deliberate misrepresentation. The motives and aims of men on both sides have been impugned, in many cases without a shadow of reason; men who nobly fought for four years to maintain and preserve this government, men whom in our sober senses we all know to be good and patriotic citizens, have been freely charged with deliberately and intentionally trying to upset the established order of society, for no other reason than that they had opinions on the political questions of the day.

Experience teaches us to expect a great deal of foolish talk during a Presidential campaign; but it seems as though there was more of it than usual this time, and that it was considerably more foolish than usual.

However, we can all settle down to work again now, and present indications point to the fact that there will be, this winter, no very great lack of work to do. We hope every reader of the "American Machinist" will have plenty of work to do, and that the pecuniary results to him

will be satisfactory. We engage to do our best to bring about this result. We of course, hope those who do not read this journal will also be prosperous; but if they have to do with the production of machinery, they are neglecting one of the most important instruments of their own prosperity, and "Heaven helps those who help themselves."

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Unskilled and Irresponsible.

Our esteemed contemporary, the "Engineering News," in commenting upon the action of the "Board of Inquiry" in the case of the grounding of the "Texas," says that "the whole accident was due to the lack of a sufficient number of trained steam engineers on board this important vessel, and as a consequence both port and starboard engines at the time of the accident were in the temporary charge of unskilled and irresponsible men, one a naval cadet and the other the chief machinist."

Our contemporary seems not to know that a man holding the position of Chief Machinist in the navy holds it by reason of his knowledge of marine and general steam engineering and experience in handling the engines of naval vessels. Such men regularly stand watch in the engine-rooms and ordinarily become even more familiar with the actual handling of a given ship's engines than the Chief Engineer can be. In other words, an engine of a naval vessel, handled by the Chief Machinist, is usually in the hands of the most competent handler of steam engines on board the ship, and to say that such a man is "unskilled and irresponsible" is sheer nonsense.

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On a preceding page of this issue we publish an article on the outlook for machinery in China and Japan. This article was written by a man who has for some years and in fact now resides in Shanghai and is thoroughly familiar with the matter of which he writes. His article will well repay perusal, and from this, as well as by conversation with Mr. Van Bergen, we are convinced that important markets for American machinery may be opened in China and Japan. We shall endeavor to keep our readers informed regarding the matter.

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Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(192) C. asks: Suppose two safety bicycles are geared, say, to 70 inches; one bicycle has 8 teeth in rear sprocket and 20 teeth in front sprocket; the other bicycle is also geared to 70 inches, but has larger sprocket at rear and front. Both bicycles have 7-inch cranks; both bicycles are to run at the same rate of speed. Does it require more power to run the bicycle having 8 and 20 teeth in sprockets than it does to run the other? Is there more friction on the rear bearing of one wheel than the other? A.—The same power would be required for the same gear, except for the difference in frictional resistance of chain and rear bearing, and this would be greatest in the machine with the smaller sprockets.

(193) H. C. Co., New York, asks: Do you know of a lubricant or compound which will make rawhide, used for belting purposes, more soft and pliable? A.—Chas. A. Schieren & Co. answer this question as follows: "We do not know any particular lubricant more suitable than any other for rawhide belting. Our idea in regard to belt dressing is this, viz., that the manufacturer of the belting should be consulted on this subject; what is good for the belting when it is originally made, in the line of a belt dressing (because all belts have been dressed when new), is good thereafter, and the best thing is to use the same article, and then hold the belt responsible for its acts. Getting a foreign substance afterward is as much as to say that it was of no consequence what the belt was dressed with when it was new, and lots of belts are injured by parties putting some concoction worse than a patent medicine on their belts, because some of those wiseacres traveling around the country state it is good. We believe if you will recommend your readers to use the belt dressing that the maker of the belt recommends, it will be more in their interests than anything else. However, tallow is supposed to be a very good thing for rawhide, we should imagine."

(194) S. L. C., Cleveland, O., asks: In cutting a long screw in the lathe with a heavy cut so that the screw is twisted more or less while the cutting is going what will be the effect of the torsion upon the pitch? I, of course, do not mean that the screw is permanently twisted, but that it springs around away from the tool when it is cutting. A.—We assume that the torsional movement will be greatest at the end farthest from the dog or driver, and that there will be little or no twisting near the dog. In that case the effect will be to make the pitch of the screw somewhat less or finer than it would be if there was no twisting. In commencing the cut near the dog and cutting toward the tail-stock end, as when cutting a left-hand screw, or when cutting a right-hand screw with the tool at the back of the work, the effect of the torsional springing of the screw would then be to increase the pitch or to make it a little coarser. It might be possible to take advantage of this principle in cutting a new screw when the lead screw is known to be a little in error, if the error is known to be constant for the length of it. A prony brake might be applied to the tail-stock end of the screw and a certain amount of torsion maintained during the cutting; and then when the torsional strain was removed, the variation of lead, as indicated above, would be realized.

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Business Specials.

Transient Advertisements 40 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear wheels, gear cutting. Grant; see page 14.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Engine Castings ⅛ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Patent Soliciting of High Class.—D. Walter Brown, Counsel in Patent Cases, 111 Broadway, New York. Send for "Brief History of Patent Legislation."

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New Ratchet Stop for Micrometer Calipers.

We give herewith an engraving showing a new ratchet stop which is now applied to micrometer calipers by the Brown & Sharpe Manufacturing Company. Its prime object is to insure that the contact points shall be closed upon work to be measured with the same pressure in all cases, and thus conduce to the accuracy and facility of making such measurements.

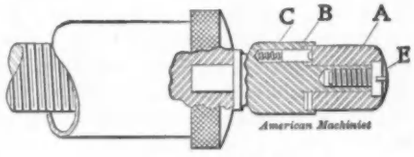

Fig. 2

RACHET STOP FOR MICROMETER.

As shown in the sketch, the lower end of the thumb nut *A* forms the ratchet and is held in place by the screw *E*. The pawl *B*, which engages the ratchet, is held against the same by the spiral spring *C*. It will be easily seen that the combination of ratchet and pawl is such that, when closing the tool upon pieces to be measured, it can be closed repeatedly with an even pressure. If more than a certain degree of pressure is exerted, the ratchet *A* will slip by the pawl *B* and prevent turning the measuring spindle.

In opening the tool, the pawl positively engages the ratchet so that it cannot slip by, thus making the ratchet stop positive in its return.

Both the ratchet and pawl are hardened, and the wear on these parts is practically imperceptible.

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A rather notable event in machinery lines is a contract made by the "Daily Chronicle" Company, of London, with the Bagley & Sewall Company, of Watertown, N. Y., for a very large paper-making machine. This is the first important machine of its class made in this country to go to England, and it will weigh between 125 and 150 tons, and will be 137 inches wide, equipped with all modern devices, including 30 large drying cylinders. It will be set up in the "Daily Chronicle" paper mill at Sittingbourne, England, and is expected to be ready for shipment in January and in operation the following April.

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It is reported that the Russian Government will erect and equip a mint for the production of its own coins, Russian coins having been heretofore minted in France and England mainly.

Commercial Review.

NEW YORK, SATURDAY EVENING, NOV. 7TH.

THE RESULT.

The few days that have elapsed since Election have brought with them newspaper columns full of reports telling of the opening and extension of operations by mills, shops and factories.

Among the works which are starting in for a greater activity, the iron and steel furnaces and mills are prominent. The lighting of the furnace of the Tonawanda Iron & Steel Company by a gentleman in Canton, O., whose name has of late been somewhat before the public, is a sample of the awakening of the iron industry. When the Illinois Steel Company proceeds to open the doors of its works, and the Carnegie Company gives orders to go ahead with improvements to its plants to cost $500,000, and much more, it is said, besides the completion of the Butler & Pittsburg road to the Lakes, and the letting of contracts for iron bridges, etc., to the amount of $250,000, it looks as though the business improvement were no sham. The price of pig iron has already made a jump. Favorable reports as to re-entry upon operations come from the Birmingham region.

A writer from Pittsburg ventures this assertion: "Every mill and workshop in Pittsburg is operating more actively, or is preparing to start on Monday." A million dollars is to be invested in wood pulp and other woodworking mills in West Virginia. Reports from New England and elsewhere show that the textile and the jewelry trades are brightening, the latter being a sensitive criterion of good times.

The railroad shops have received a sharp impulse to reawaken activity. Among those which are already about commencing or extending operations, the following are reported: Big Four, Erie, Lehigh Valley, Baltimore & Ohio, Chesapeake & Ohio, Wabash, Iron Mountain. Officials of the Pennsylvania and the Missouri Pacific express sanguine expectations. Several departments of the former will be put on increased time, to fill accumulated orders for new cars. The demand for more cars for the accommodation of increasing traffic is causing the names of car-building establishments to stand out conspicuously among the factories now starting up. Those mentioned include the Barney & Smith, Ensign, Ohio Falls, South Baltimore and those at Mount Vernon, Ill.

Some of the companies most closely allied to the interests of our readers, which have begun to act in a confident manner, are the Niles Tool Works, the Arcade File Works and the Stillwell-Bierce Company. Tippet & Wood, boiler-makers, of Phillipsburg, N. J., have orders placed contingent upon the result of the Election, which it will take until January to fill.

In view of the weak feeling that has existed in the cycle business, some of the reports now made by those engaged in this line of manufacture are encouraging. The following concerns, at least, are beginning more extensive work, or otherwise report a better feeling: Pope, Overman, Warwick, Crawford, Hamilton, Barnes, Lozier, Syracuse, Snell, and Rouss, Hazzard & Co.

In the midst of all this domestic activity, however, we cannot overlook certain foreign orders. One of these is that for two cruisers, given by the Japanese Government to the Cramps, of Philadelphia, and the Union Iron Works, of San Francisco. The other is for a paper-making machine, of 125 to 150 tons weight, placed by a representative of the "Daily Chronicle" Company, London, with the Bagley & Sewall Company, Watertown, N. Y.

EXPORTS OF MACHINERY

from the port of New York, of which manifests were given out during week ending October 31st, we compute to amount to $273,643; during the month of October, about $1,030,000; for the week ending November 7th, $162,177.

PITTSBURG REPORT FOR OCTOBER.

Owing to the hurry incident to Election, our monthly Pittsburg report was delayed from last week, and we now give the substance of it. Our correspondent stated that the iron market showed increased demand and improving prices for raw iron, rather than for finished products, with a decidedly more hopeful feeling as to the outlook. The foundry trade, though depressed, showed some improvement. The Westinghouse plants were running fairly well, but could stand a great many more orders. The projected extensions, improvements to machinery, etc., were such as to indicate an avalanche of business if the Election went in the desired way. At present even those who had capital were unwilling to risk it, and many orders were contingent upon the Election. The best trade now seemed to be among the engine men, as many electric light and waterworks systems were being installed. Machinery was dull, but the warehouses were pretty well stocked with goods to be shipped as soon as the results of the Election in a certain way were assured.

Quotations.

NEW YORK, Monday, November 9th.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$12 25 @ $13 50
No. 2 foundry, Northern	11 75 @ 12 50
No. 2 plain, Northern	11 00 @ 11 50
Gray Forge	11 00 @ 11 25
No. 1 foundry, Southern	12 25 @ 12 50
No. 2 foundry, Southern	11 50 @ 11 75
No. 3 foundry, Southern	11 25 @ 11 50
No. 1 soft, Southern	11 75 @ 12 00
No. 2 soft, Southern	11 25 @ 11 50
Foundry forge, or No. 4 Southern	10 75 @ 11 00

Bar Iron—Base—Mill price, in carloads, on dock: common, 1.15 @ 1.20c.; refined, 1.25 @ 1.50c. Store prices: common, 1.40 @ 1.50c.; refined, 1.50 @ 1.80c.

Tool Steel—Ordinary sizes, standard quality, 5 @ 7c.; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—From store, 1.65 @ 1.75c. Special brands upward.

Cold Rolled Steel Shafting—Base size in carloads, about 2⅛c.; 2¼c. for smaller quantities from store.

Copper—Carload lots, Lake Superior ingot, 11 @ 11¼c.; electrolytic, 10⅞ @ 10¾c.; casting copper, 10¾c.

Pig Tin—For 5 and 10-ton lots, 13 @ 13¼c., f. o. b.

Pig Lead—In carload lots, 2.95 @ 3.00c., f. o. b.

Spelter—In carload lots, New York delivery, 3.95 @ 4.00c., f. o. b.

Antimony—Cookson's, 7¼ @ 7⅜c.; Hallett's, 6½c.; Japanese, 6¾c.

Lard Oil—Prime city, present make, commercial quality, in carload lots, 42 @ 45c.

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Manufactures.

The Pittsburg mill of Jones & Laughlin has resumed operations.

E. H. Roseberry and others will build a new saw mill near Mobile, Ala.

The Anderson Iron & Bolt Co., Anderson, Ind., has resumed full operations.

The Birmingham Foundry & Machine Co., Birmingham, Ala., will enlarge their plant.

Max Guggenheimer contemplates erecting another large cotton mill at Lynchburg, Va.

The Seneca Glass Co. have moved their factory from Fostoria, O., to Morgantown, W. Va.

The electric light company of Sherbrooke, Que., Canada, have decided to increase their plant.

The Niles Tool Works, and other shops at Hamilton, O., have increased their working forces.

The James Harris Nail & Barbed Wire Co., of Janesville, Wis., are going to enlarge their plant.

It is reported that the Indiana Iron Works, Muncie, Ind. will increase its working force and time.

Arcade File Co.'s plant, Anderson, Ind., which has been idle for some time, has resumed full operations.

McIntosh, Minn., will erect a city lighting plant. Most improved electrical machinery will be installed.

The Kansas City, Pittsburg, and Gulf R. R. will construct a connecting road with the Gulf of Mexico.

Grand Haven, Mich., will erect a city lighting plant. Most improved electrical machines will be installed.

The Bundy Manufacturing Co. of Binghamton, N. Y., makers of time recorders, have resumed operations.

Wylie & Shaw, of Almonte, Ont., Canada, have decided to increase the machinery plant in their woolen mill.

A new and entirely equipped machine shop will be built by the Standard Horse Shoe Nail Co., of Beaver Falls, Pa.

Union Hill Mining Co., it is said, are to erect a smelting plant at Minneapolis, Minn. This plant will cost $283,000.

The Burgess Iron Works, Portsmouth, O., which has been working with a short force, will put on a full force immediately.

Messrs. Ritchie & Co., St. John, N. B., are erecting a new mill at Newcastle to replace the one burned in September last.

Francis Frost & Co., paint manufacturers, of Toronto, Canada, have decided to establish a branch factory at Niagara Falls, Ont.

The Beetem Lumber & Manufacturing Co., Carlisle, Pa., will erect a two story brick building 50 x 100 feet, and place new machinery.

The works of the National Acid Company, burned recently at New Orleans at a loss of $100,000, will be rebuilt. John S. Rainey is president.

United States Glass Works, Glassport, Pa., expect to locate two plants near the present works soon, one of which is to be a steel works.

At Dayton, O., the Stillwell-Bierce Co. and the Barney & Smith Car Works, will begin operations in full, the latter with a force of 2,000 men.

The Brady Manufacturing Company's new plant, Derby, Conn., has been built up to the top story, and workmen are busy putting on the roof.

The Crawford Bicycle Works, of Hagerstown, Md., are to put on a large force of hands and expect soon to be employing nearly 2,000 men.

J. W. Paxson & Co., manufacturers of foundry

(Continued on page 36.)

AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

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The Balancing of Beam Engines.

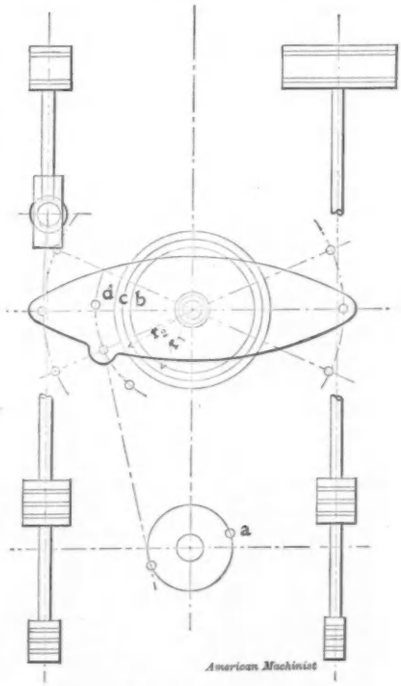
We received an inquiry recently regarding the method of calculating the balance weight of beam engines. The question is too large for adequate treatment in our Questions and Answers column, and as the subject is of general interest we take it up here.

One correspondent sends us a sketch of the arrangement of the parts which we reproduce. The question is: What is the necessary counterweight to be applied at *a* in order to balance the inertia of the reciprocating parts, beam included? The data given are not sufficient to solve the problem in actual figures, which solution would, in fact, be somewhat tedious, and would involve an array of figures scarcely appropriate here; but the principles involved are comparatively simple, and it will be sufficient for the purpose to show how the work is done.

In the usual form of horizontal reciprocating engine, the problem is much simplified by the fact that the movement of the reciprocating parts is in a straight line, and the velocity of reciprocation of all the parts is the same, and, moreover, neglecting the influence of the angular vibration of the connecting rod, is the same at any instant as the horizontal component of the velocity of the crank pin.

It is well known that the disturbing effect of the inertia of the reciprocating parts of the usual form of engine, as the crank passes the center, is equal to the centrifugal force of a mass of metal of the same weight as the reciprocating parts concentrated at the center of the crank pin, and an engine having a counterweight generating an equal centrifugal force will be balanced in the direction of reciprocation. In such an engine, all the reciprocating parts having the same velocity, the calculation of the force to be counterbalanced is simply a matter of the velocity and total weight. With the beam engine the case is very different. All particles of the pistons, piston rods and crossheads have the same velocity; but the velocity of the particles of the beam varies with the distance from the center of motion, and the total effect is the sum of the effects of the various particles. Moreover, while the pistons and crossheads move in straight lines, they are in the present case connected to the beam at a greater distance from the center than the connecting rod, and their velocity and disturbing effect are obviously greater than if they were connected at the same distance and had the same velocity as the connecting-rod pin.

Considering the metal in the beam, it is obvious that the effect of a pound of metal near the end will be greater than that of a pound near the center, and that there is a point between the two where both pounds might be placed and produce the same effect as in their actual



BALANCING BEAM ENGINES.

locations. Precisely so for the entire beam. There is a point in its length where its entire weight, if it could be concentrated, would produce the same effect as the beam in its actual form. Similarly, too, there is a point in the length of the beam where the weight of all the reciprocating parts may be conceived to be concentrated and produce the same effect as in the actual engine.

The problem comprises two steps: First—We have to find the point on the length of the beam where the entire weight of the reciprocating parts would, if concentrated, produce the same inertia effect that they do in the actual engine. The distance of this point from the center of motion is called the "radius of gyration" of the system.

Second—Having found this point, we have then to find what weight attached at the connecting-rod pin would have the same effect as the entire weight at the radius of gyration, which, as was just said, is the same as that of the actual parts of the engine.

The first step will be accomplished by assuming the parts to be in motion at some assumed speed, and determining the stored energy of the system.

If a circle be drawn from the center of the beam, all the particles on that circle will have the same velocity, and the energy of all the particles on the circle can be obtained from this velocity, and the total weight of all of them, and similarly for any other circle. Could we draw a circle for every circle of particles, compute the energy of each and add them together, we would obtain the desired result; but this by ordinary methods is clearly impossible, as the number of circles would be infinite. This result, however, is obtained in a few cases by the methods of the calculus, the result being the exact sum of the energy of all particles, the same as though each could be computed by itself and the sum of all were then found. The methods of the calculus are, however, applicable to only a few cases, and those cases would never occur in the present problem. Thus, if the beam were a true circle or square, or if it were a disk fly-wheel with a heavy rim, and without bosses or irregularities of any kind, the exact energy of the body could be found. In a case like the present one, however, an approximate solution is all that can be obtained.

The method is closely analogous to that given by Mr. Walter Ferris, in his article on the "Derivation of the Formula for the Strength of Beams," which appeared in our issue for April 16th, and consists in dividing the beam into strips by circles, as shown. If we assume the system to be in motion, and the velocity at one foot from the center of the beam to be w, then the velocity at a radius r_1 will be $r_1 w$, and at a radius r_2, $r_2 w$, and so on. The stored energy of any

moving weight is the product of the weight by the square of the velocity and divided by 64. Now let two circles *b c* be drawn as shown, the mean radius being r_1: The velocity at this mean radius is $r_1 w$. Determine the weight of metal lying between these circles, which call W_1: The stored energy of this weight at this velocity is $\frac{W_1 r_1^2 w^2}{64}$. Similarly, draw a third circle *d*, making a second strip of mean radius r_2, whose weight call W_2. The velocity at radius r_2 is $r_2 w$, and the stored energy of the weight is $\frac{W_2 r_2^2 w^2}{64}$ Proceed in this manner until the entire beam has been taken in, and with the strip which takes in the piston-rod connection include the weight of pistons, rods and crossheads. We shall thus obtain a sum which will be the stored energy of the whole at the velocity chosen, and it will be the sum of $\frac{W_1 r_1^2 w^2}{64} + \frac{W_2 r_2^2 w^2}{64} + \frac{W_3 r_3^2 w^2}{64} +$ all the others, and it may be written $\frac{w^2}{64}(W_1 r_1^2 + W_2 r_2^2 + W_3 r_3^2 +$ all the others).

The sum of all the weights will equal the total weight, which we may call W; and it is clear that if we divide our total energy by $\frac{w^2 W}{64}$ we shall obtain a value which we may call r^2, and by extracting the square root we find r, which is such that if the entire weight could be concentrated at this distance r from the center of motion, it could replace the actual system so far as the stored energy is concerned. This value r is the desired radius of gyration of the system. If the connecting-rod pin happened to be at this radius, the counterweight would equal the entire weight of the parts, that is, W, precisely as in the usual form of engine; but ordinarily, of course, this would not be the case, and it becomes necessary to find a weight W_x which at the radius of the connecting-rod pin may replace the weight W at the radius of gyration r. The velocity at radius r is $r w$, and the stored energy is $\frac{w^2}{64} W r^2$. Call the radius at the connecting-rod pin r_a, and the velocity at that point becomes $r_a w$. Similarly, the stored energy of a weight W_x at this point is $\frac{w^2}{64} W_x r_a^2$. But these stored energies must be equal; that is,

$$\frac{w^2}{64} W r^2 = \frac{w^2}{64} W_x r_a^2,$$

or dividing out $\frac{w^2}{64}$,

$$W r^2 = W_x r_a^2,$$

$$\text{or } W = W \frac{r^2}{r_a^2},$$

the required value of the counterweight.

In these calculations, that old disturbing element, the angular vibration of the connecting rod, has been ignored, as it should be in practice, because its effect is to call for a counterweight heavier than the one thus determined at one end of the stroke and lighter at the other. In other words, the weight determined as above is a correct average. There would also be a slight disturbing element due to the angular vibration of the links, which connect the crossheads with the beam pins, which, by slightly affecting the velocity ratio between crossheads and beam pins at the ends of the stroke, would give the weight of the pistons a slightly different inertia value at the ends of the stroke than has been assumed. This could be allowed for if it were worth while, which it probably would not be.

The value determined is also that for complete balance in the direction of reciprocation of the connecting rod, as is correct for horizontal engines. Whatever proportion of the reciprocating parts is balanced, the method is the same up to the point where the counterweight is determined, when it becomes simply a question of what percentage of W_x shall be counterbalanced.

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Bursting Test of a High-Pressure Air Receiver.

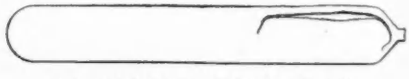
We recently witnessed a test to bursting under hydrostatic pressure of a receiver intended for holding compressed air up to a pressure of 2,000 pounds to the square inch. The test was made at the Watson & Stillman Works in this city, whose well-known specialty of hydraulic pressure apparatus gives them unusual facilities for this line of work. We noticed, by the way, while there the coupling-up and testing in progress of a series of ten hydraulic pressure cylinders to be used in forcing along a Greathead shield in a tunnel now being excavated in Boston.

The test was under the direction of Professor Jacobus, of the Stevens Institute, who will, of course, render a detailed and exhaustive report, so that it will only be proper for us to speak of it in a general way.

The receiver tested was not in any way a special article, but was merely one taken without choice from a large number of similar ones supplied to the American Air Power Company for use upon their compressed-air motors, and furnished by Chas. G. Eckstein & Co., of this city, as agents for the Mannesmann Works, in Germany, where the receivers were made. These receivers are all tested to a pressure of 4,000 pounds per square inch before leaving the works, so that it was known that this pressure must be considerably exceeded in order to succeed in bursting the present one. The dimensions of the receiver were 9 3-16 inches external diameter, 5 feet 6 inches length over all, and 5-16 inch for the thickness of the cylindrical walls. The ends were somewhat thicker, and thickest at the center. The weight of the tube from which the receiver was made is 33 pounds per running foot. The straight tube is cut off to the required length, and then the ends are worked down and closed, bringing the finished article to the shape shown in the sketch.

The receiver was filled with water and laid horizontally upon a couple of horses, and the pressure applied by a hand-pump connected by a pipe with the small end. Professor Jacobus had marked half-a-dozen equidistant positions upon the cylindrical surface and noted the circumference at each point before the pressure was applied. The pressure was applied and let off again several times, each time a higher pressure being applied than before. The steel tape showed the enlargement of the circumference under the pressure and its return to normal dimensions when the pressure was released. No permanent set was shown until a pressure of 4,500 pounds was reached. The measures were taken for circumferential enlargement and for the elongation up to 5,000 pounds, beyond which it was not considered safe to go.

The receiver burst under a corrected gage pressure of 5,760 pounds. When testing such an article as this by hydrostatic pressure, we all know that as the water is non-elastic there cannot possibly be any danger. When the metal gets tired of resisting any longer it merely lets go, and the water oozes out and that ends it. As a matter of fact, the exterior was watched carefully by many eyes, and



THE BURSTED AIR RECEIVER.

there was not the slightest trace or suggestion of any oozing. There was a sharp report, a flash of water that quite thoroughly drenched three or four who stood at the end supposed to be most safe, and the receiver was thrown three or four feet, breaking the pipe connected to it. While the water is non-elastic, the steel shell is different, and has sufficient elasticity to drive the water with considerable force after the rupture occurs. The shape of the fracture, as hinted in the sketch, showed this. The first rupture was undoubtedly on the straight part, and at the place where the opening is the widest and the bulging the greatest. The ends of the fracture were torn by the opening action of the out-rushing water after the first opening was made.

The fracture showed the metal to be absolutely flawless and perfectly homogeneous. There was not the slightest splinter or separate particle detached from either side. The calipers showed a permanent increase of 5-16 inch in the diameter of the body of the receiver for the entire length beyond where the rupture occurred. When these receivers are tested to bursting, they always part at the side

and never at the end, as the strain upon the metal is considerably less endwise than sidewise. If the metal parts first near the middle there is usually only the longitudinal slit, and little or no tearing of the ends of the fracture in a different direction. In this case the length of the straight fracture was about 20 inches, while the total length of it was about 30 inches. The test may be considered highly satisfactory, and should greatly promote confidence in the safety of the receivers at the pressures and under the conditions attending their employment.

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Bicycle Brazing.

The art of brazing, or uniting pieces of iron by the use of brass as a solder, is very old, and was very largely in use among the locksmiths and makers of ironmongery up to the time of the invention by the French of the drawing press. The application of that most important tool to the manufacture of a vast number of articles from a single piece of metal which had been previously made by forming in separate pieces and brazing together, had the effect of greatly changing previous methods of manufacture, so that brazing and silver soldering of iron had become, at the date of the inception of extensive bicycle manufacture, comparatively little practiced. From the first, some cycle makers made use of brazing, although others in the early days, about 1868, relied wholly upon welding; but there was always a strong leaning towards a tubular frame cycle construction, and it was speedily found that no screwed cycle frame joints could be made secure against working loose under the constant jar and shaking entailed by road use of the rigid-tired wheels of those days, and it was common practice to either pin or braze the screwed pipe joints of the "bone-shakers." The old cycle frame tubes were made of common iron pipe, which had sufficient thickness for threading; but when the diamond frame came in, the thin tubes employed had so little thickness that soldering in some form became a necessity, and brazing came to the front as the most important and most difficult and expensive and uncertain single manufacturing step in the production of the bicycle; and, as was to be expected, the practice of different cycle makers, confronted with the new problem, widely varied, and was in no case entirely satisfactory. There is even now great diversity in the forms of brazing fires, and it can be truly said that there is no other cycle-making process which is to-day so varied in the means employed in its execution, and so uncertain in its results, as brazing. It is impossible to subject the brazed joints of a cycle to inspection of any sort, because the only possible method of efficient inspection involves the destruction of the finished work. To "inspect" a brazed joint, it would be necessary to saw the joint across in several directions, smooth the cut surfaces, and examine the brazed joinings with a glass to ascertain the completeness of the soldering, and finally to tear the brazed joints of the fragments apart to test the strength of the adhesion. Such an inspection is manifestly impossible except in occasional instances. The master brazier can do no more to insure the perfection of his work than to make some experimental brazes, carefully noting the steps employed, inspect the work by some form of destructive test, and then, in case his first result has been satisfactory, he can proceed to carefully duplicate his operations, relying solely upon the fidelity and care with which his workmen follow every detail of the process which in the experimental brazings produced good work.

Brass of various mixtures and proportions of copper, tin and zinc, in the form of wire, shredded brass plate or coarsely and finely granulated "spelter," is the solder invariably used in bicycle brazing, and borax in some form is used for the flux.

"Spelter" may mean almost any combination of copper, tin and zinc, and different spelters undoubtedly vary very greatly in tensile strength, and certainly vary vastly in point of fusion temperature. The tendency is at present, I think, to use spelters which flow at low heat, and which probably have a relatively low tensile strength, which would seem to be correct practice, as the surfaces united by brazing in cycle work are invariably of such great extent in proportion to the cross-section area of the parts united that only a low

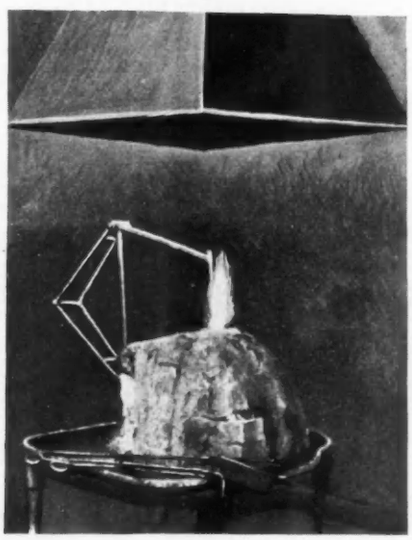


Fig. 1. "CLAY PILE" BRAZING FIRE.

tensile strength of the solder is needed to give a resistance to separation greatly in excess of the strength of the members themselves; while a spelter flowing freely at very high temperatures only, entails the possible injury of the steel tubing by overheating unless the workman is both very skillful and very careful. A low-heat flowing spelter adds greatly to the certainty of filling the brazed joint full of fluid metal, and makes the whole process of brazing much more open to observation and much more likely to secure good results, and some of the spelter which I see used in the best shops flows very easily indeed, a low, red heat of the frame parts being ample to make the spelter flow freely.

The old braziers used fires of soft coke,

Fig. 2. HAND TORCH, WARWICK SHOP, 1895.

"Blossburg" coal and charcoal, blown from beneath, in common forges, bricked up to shape a muffle to suit the work in case a great many pieces were to be made. I think some hard-coal brazing fires were used also. The first cycle brazing fires were common forges, blown from beneath in some cases. All such fires have the serious fault for brazing use of being hottest at the bottom, which causes the spelter to flow freely downward off from the work. Consequently, the practice of using a coke bed or mattress of coke in a close pan, unsupplied with air from beneath, on which the work is laid, while a flame from a gas and air blow pipe or torch, either held in the hand or suspended above the forge, is directed on the work, has come into vogue. This method causes the top of the work to become heated first, so that the spelter starts to flow on top and gradually runs down, filling the joint perfectly, as the under side of the job is kept hot by the coke, which becomes incandescent, but burns and wastes very slowly because it has no air supply. Some shops continued the use of open fires, blown from beneath, for a long time, and early in 1895 I saw many such fires in use; but the employment of the overhead torch and coke-bed gave the better results, and is still largely in use.

Another form of brazing fire was that of the clay pile, shown in Fig. 1, which consisted of a large mound of wet clay heaped on the top of a forge fire blown from beneath, and pierced with a vertical hole in the middle, into the top of which the work to be brazed was thrust; the fire was fed from the top with fine soft coal,

"Blossburg" being generally used. This rude form of brazing furnace gives good results for some shapes of cycle joints, and was very extensively used in the early days by some excellent firms, but is now possibly obsolete.

The two fires mentioned may be termed "single fires," as they used but one flame. Double fires, in which two horizontal jets of gas flame are directed towards each other so as to meet in a sunflower-shaped flame of intense heat, were well known in some places before cycle brazing was of much importance. The first of these double gas fires I ever saw was used at Colt's Armory for soldering together the barrels of double sporting guns, and substantially the same fire is now the most approved form of brazing furnace. The fuel used is either natural or naphtha gas, the naphtha gas being generally made by a gas machine, though in some cases it is used directly from a buried tank encircled by a turn or two of live-steam pipe, the heat of which is regulated to cause the sufficient evaporation of the naphtha or gasoline in the tank, which is made to hold as much as twenty barrels in some cases. There are various gas-making machines in use, all of which seem satisfactory in operation.

With the double flame, various forms of furnace or muffle are used, which are often built up of firebrick on iron stands to suit the shape of the work to be brazed, or, as it seems in some cases, merely to meet

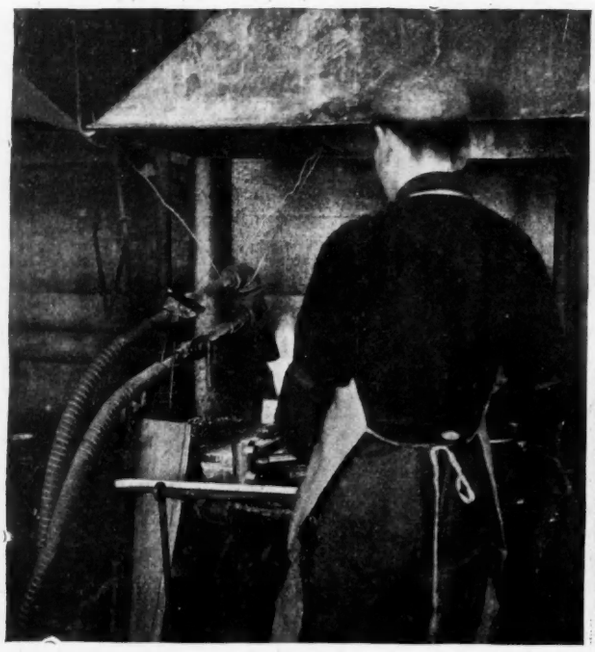


Fig. 3. SUSPENDED TORCH AND COKE BEDS, LIBERTY SHOPS, 1895.

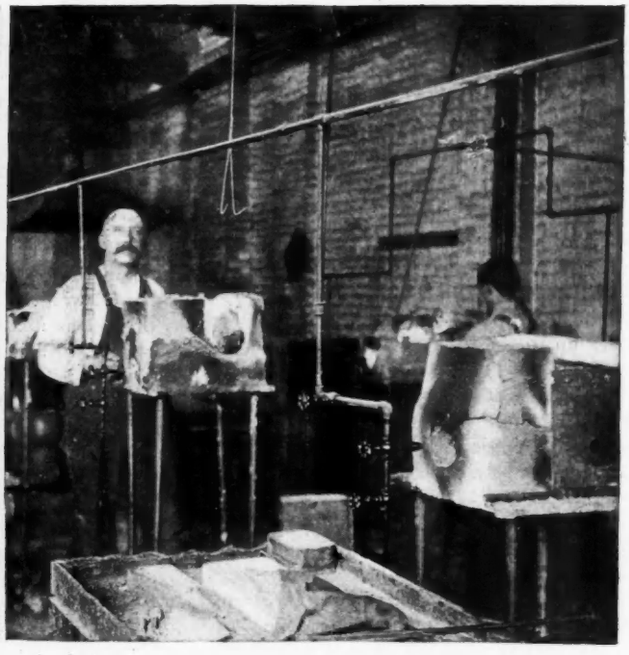


Fig. 4. SINGLE AND DOUBLE HORIZONTAL FLAMES, WARWICK SHOPS, 1895.

Fig. 5. LOZIER DOUBLE HORIZONTAL FLAME FIRE SHOWING SUNFLOWER FLAME.

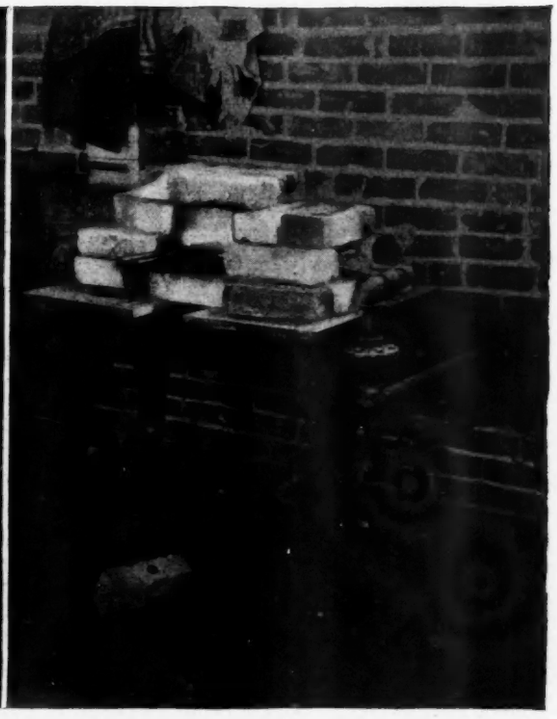


Fig. 6. LOZIER FIRE, MADE UP WITH LOOSE BRICKS.

the fancy of the workman. Endless illustrations of brazing fires might be given; but it seems more to the purpose to give examples from two excellently equipped brazing rooms—that of the Lozier shops, Toledo, O., photographed in April, 1896, and the Pope — "Columbia" — brazing room, the pictures of which were taken very recently. I therefore present illustrations mainly from these two shops, the others given being simply illustrative of the transitional stages of the art of cycle-brazing.

Brazing fires are located in all possible positions in regard to the remainder of the factory, but perhaps more commonly in the smithy than elsewhere. It is quite convenient to locate part, at least, of the brazing fires in close proximity to the frame fitters and filers; and in the Gormully & Jeffery shops, part of the brazing fires are in the basement of one building in the smith shop, and the remainder are on the fourth floor of another building, around two sides of the sandblast room and contiguous to the frame fitters, filers and polishers. In the Sterling, single-floor, one-room shop at Kenosha, Wis., the brazing fires are almost in the center of the departments, and the grinding is close to them, all open, there being no partitions in the Sterling work shop. The japanning and sandblast and hardening rooms are in separate structures. In the case of the Sterling shops, there is a large hood over the brazing fires, and there are suction pipes for the grinding wheel which is saved by the Gormully & Jeffery and Sterling plans, but has advantages which seem to fully justify the separate brazing room idea. The pictures quite clearly show the Sterling and Columbia

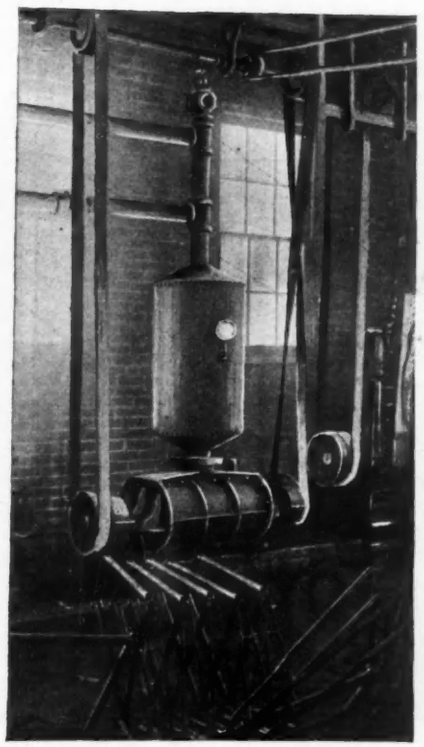


Fig. 7. LOZIER AIR BLAST PLANT FOR BRAZING ROOM.

Fig. 3 shows a suspended torch, wired up to the hood of the forge, from the Liberty shops at Rockaway, N. J., 1895.

Fig. 4 shows single and double horizontal flames, blown through firebrick blocks, and is from the Warwick shops, Springfield, Mass., 1895. This Warwick fire is the prototype of the 1896 Lozier fires, shown in Fig. 5. These fires are very fine, and are considered by the Lozier management to be among the very best. The fires are made of two horizontal air and gas torches, the burners enter-

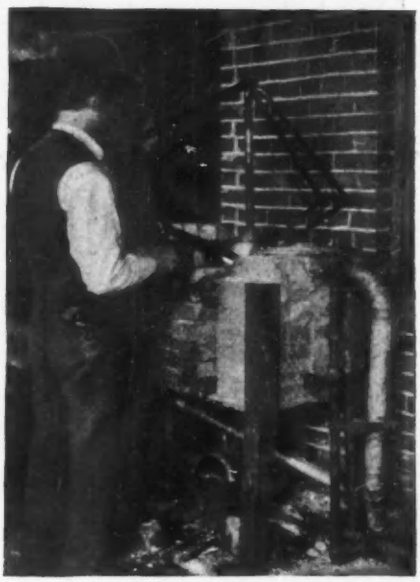
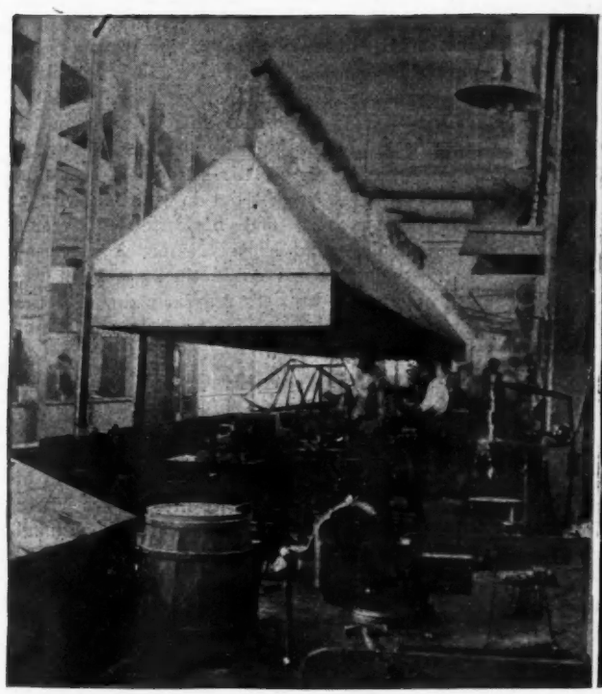


Fig. 8. FRAME BRAZING FIRE—YOST.



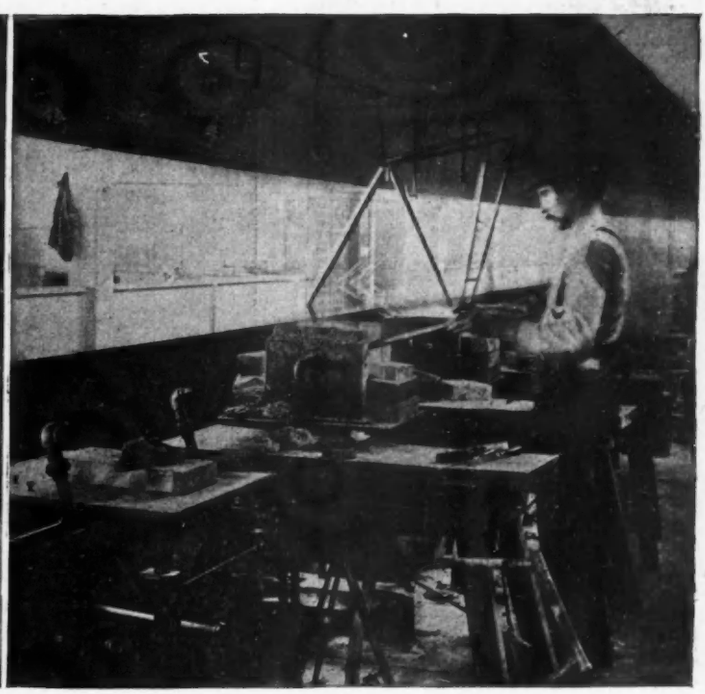


Fig. 9. STERLING BRAZING FIRES IN MIDDLE OF OPEN SHOP.

Fig. 10. STERLING FIRES.

stands which keep the place perfectly clean and free from brazing vapors and emery dust. The Lozier and Columbia brazing shops are in separate buildings; this practice involves some handling and Warwick brazing departments, so that no more need be said in regard to the general arrangement of these rooms.

Figure 2 is a hand-torch brazing operation, from the Warwick shops, 1895, and ing the tapering holes in the two large one-piece firebricks supported on the cast-iron stands some two or three inches from the outside, and the flames slowing inward through the diminishing holes in

the firebricks to meet between them in a beautiful "sunflower" of pale rose-colored flame of intense heat, quite clearly shown in Fig. 5, which also shows the gas and air piping.

Fig. 6 shows another form of fire, made of loose firebricks piled on a similar cast-iron stand, with a double horizontal flame, same as Fig. 5.

Fig. 7 shows the Lozier air-blast rig, consisting of a small vertical engine driving a Root blower with an air tank on top of it, out of the top of which the air-pressure supply pipe is carried round three sides of the brazing room, all of the fires being located next to the wall. This is a very complete, accessible and satisfactory arrangement, well worthy of careful examination.

Fig. 8 shows a different style of double-flame fire, natural gas and air blast, from the Yost factory, Toledo, O., 1896.

Fig. 9 shows the Sterling brazing fires in the middle of the open shop, and gives a good deal of the hood construction, which has suction enough to keep the place perfectly clean and cool.

Fig. 10 is a near view of one of the Sterling fires, which are double horizontal flames, substantially the same as the Lozier fires.

as small as will suffice for the work. The work supports are hollow cast-iron bricks, made of perforated plates; these bricks were at first filled with asbestos, but this filling is not now continued in all cases.

Fig. 12 gives a very clear idea of the Columbia brazing stand and torch construction. The bricks shown in this picture are large firebricks.

Fig. 13 shows a Columbia fire built up for brazing fork crowns, and Fig. 14 shows the workman in the act of "wiping off" the superfluous spelter while yet hot, with a small iron "wiping rod." The theory in the Columbia brazing room is to braze with small fires, heat the work as little as possible, and finish all work on the outside by wiping while hot, so as to avoid the necessity of the sandblast; and this theory is carried out in practice with a completeness and perfection of result which would surprise most foremen of brazing rooms could they see what the Columbia braziers regularly do. All the Columbia brazing is daywork, as it is not considered safe to offer any inducement to the workmen to turn off a big day's work when that work cannot be tested or inspected as to its actual quality.

Another peculiar feature of the Columbia brazing practice is the employment of two hands on one fire in all cases where such a procedure is practicable, one hand brazing one side, and the opposite workman the other side of the same piece, each workman going through the same motions at the same time, and both assisting in the "wiping-off," as shown in Figs. 14 and 15.

Fig. 16 is another example of two men on drop-frame brazing.

Fig. 17 shows a Columbia fire with one workman in front, and two workmen on the next fire, brazing a motocycle tire.

I give this very full illustration of the Columbia practice because I believe that

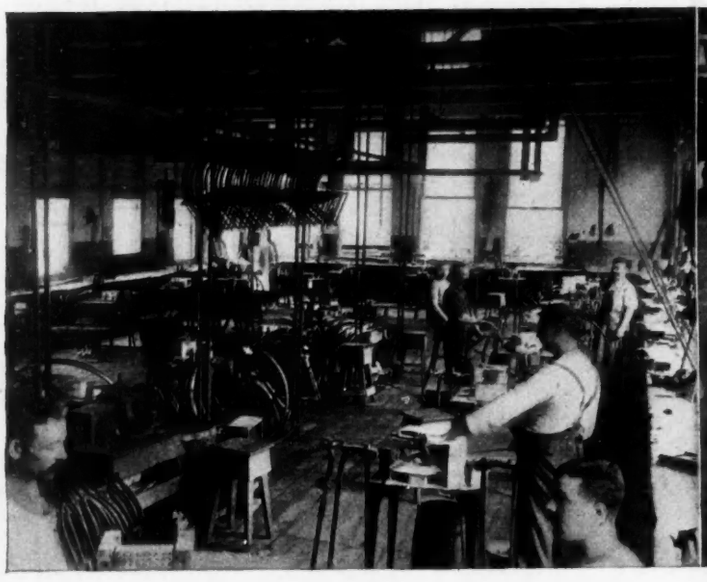


Fig. 11. GENERAL VIEW OF COLUMBIA BRAZING ROOM.

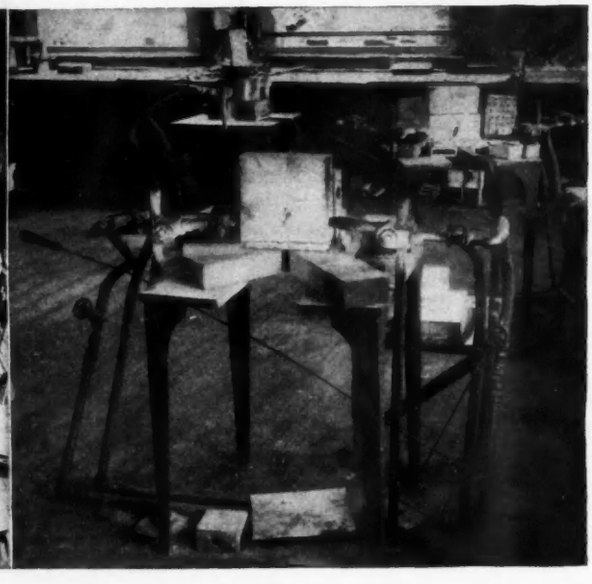


Fig. 12. COLUMBIA BRAZING. STANDARD TORCHES.

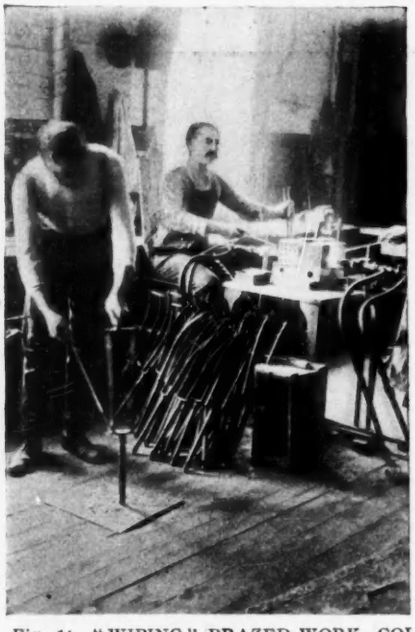


Fig. 14. "WIPING" BRAZED WORK, COLUMBIA SHOPS.

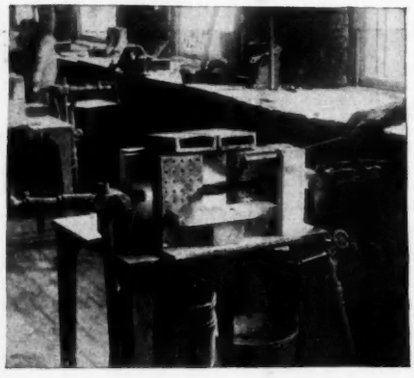


Fig. 13. COLUMBIA FORK CROWN BRAZING.

Fig. 11 is a general view of the Columbia brazing room, where the practice is to avoid bruises in frames by hanging the work overhead, instead of ranking it on the floor. This picture was taken in the depth of the summer slack season, and shows only a few hands at work on odds and ends of left-over jobs. The room has four rows of fires, one along each side and two rows down the middle space. The fires are all made on one pattern of stand, with a wide V-notch in the cast-iron top, and fitted with either one or two horizontal torches, which are arranged for a ready hand-adjustment of the air and gas supply, thus permitting a quick regulation of the size of the flame, which is always kept

it is in many points superior to any other I have seen, and I am certain that I have seen no other brazing room so clean and cool, and have nowhere else seen brazing done with so little fire and so great an appearance of uniformity. Undoubtedly, all the good cycle-makers do good brazing, because it is a rare occurrence for can a uniform excellence of work be obtained.

Unquestionably, the Columbia gains a very great advantage in doing away with the use of the sandblast. Not only is the sandblast an expensive nuisance, but it acts just as readily on the naked frame tube as it does on the slovenly lump of

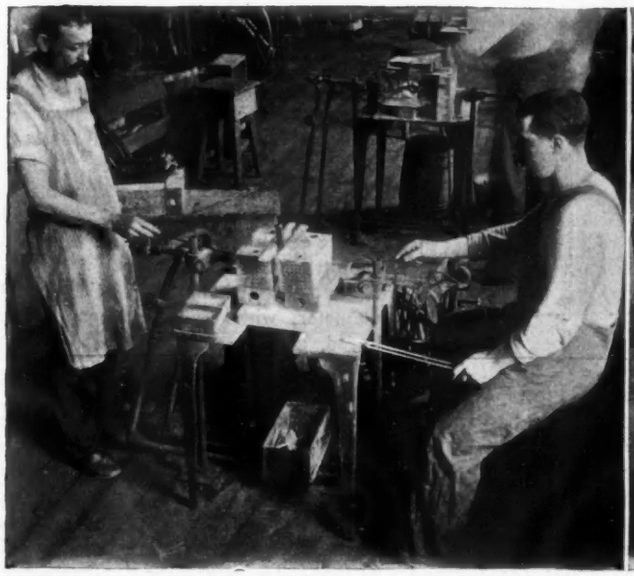


Fig. 15. TWO MEN AT ONE FIRE, COLUMBIA SHOPS.

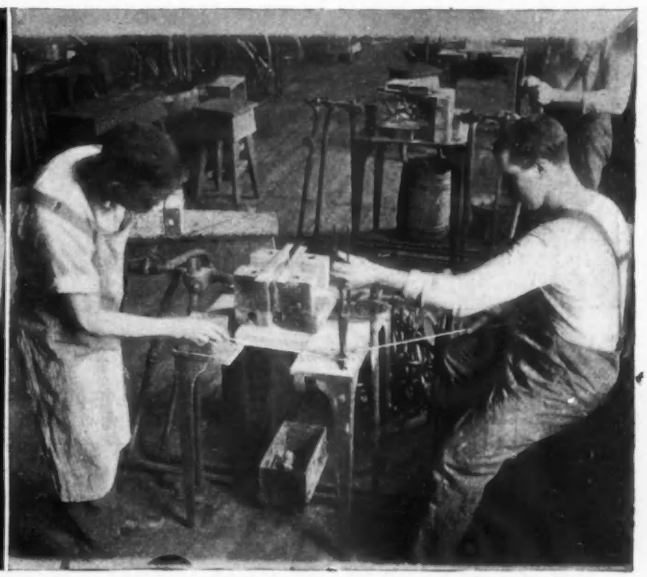


Fig. 16. TWO MEN "WIPING OFF" THE SAME PIECE, COLUMBIA SHOPS.

Fig. 17. COLUMBIA BRAZING, ONE MAN AT A FIRE.

any cycle made by a reputable firm to give way at a brazed joint; but I have nowhere else seen the work heated so little, or finished so cleanly on the outside, as at the Columbia. Every braze made at the Columbia is studied by the foreman, made in different ways and the results tested; and when the best method is decided upon, it is followed with undeviating regularity, in the belief that only by uniformity of steps in brazing a joint spelter or borax "glass" which it is designed to remove; and before the blob of borax is cut away, the naked frame tube adjacent can be very materially weakened by sand-cutting.

Clement, of Paris, the most extensive cycle manufacturer in France, told me the Pope brazing was the cleanest and neatest and, he believed, the best he had ever seen anywhere, and his opinion is of great value, as he keeps himself constantly well informed as to cycle-making processes in France, England and America by personal observation. HUGH DOLNAR.

▲ ▲ ▲

An English Opinion.

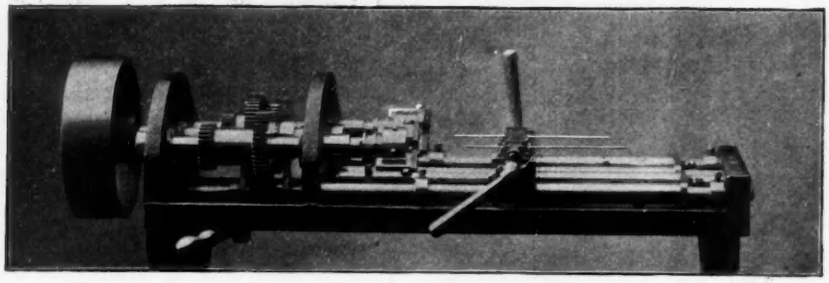
The European press, and among them we are sorry to see many English papers, have affected to laugh at the idea of American warships forcing the Dardanelles. Ignoring for the moment the political aspect of the question, we would ask: Have not those who scoff lost sight of the fact that the American Navy is daily becoming a greater power than they care to acknowledge? It is barely two years ago since an American firm asked, in all good faith, to be allowed to compete for the construction of British warships, a request which raised a storm of ridicule in our papers; and now, almost before the merriment has ceased, the same firm have secured the contract to build two 7,000-ton cruisers for the Japanese Government, vessels which, be it noted, will have to be completed in as short a time as any English firm would care to undertake delivery in. The American Navy may be a small one to-day, but we who speak the English tongue ought to be the last to undervalue the marvelous potentiality of a nation which entered upon the great struggle of 1860 with a mere handful of men, only to leave off four years later with armed forces whose numbers alone caused the whole world surprise. As with her men, so it may be with her ships should the requirement for them ever arise—a requirement which, as a kindred nation, we pray may never come.—London "Shipping World."

It certainly looks now as though no such requirement would ever be presented. A war between the United States and England would be the greatest crime of history.

Duplex Spoke-Threading Machine.

We recently illustrated and described a new die-holder, and now present an engraving of a machine in which two of them are used for threading bicycle spokes.

Two spindles running side by side are driven from a shaft lying between them, and at two different speeds, depending upon the position of the gear wheels on the pulley shaft, which are shifted by the hand-lever seen at the left.



DUPLEX SPOKE-THREADING MACHINE.

There are two double vises for holding the spokes. Each vise holds two spokes, which are sufficiently far apart so that one of them clears the die-holder while the other is being threaded. The vises shift laterally to bring the spokes successively into proper position for threading, and a single motion clamps both spokes.

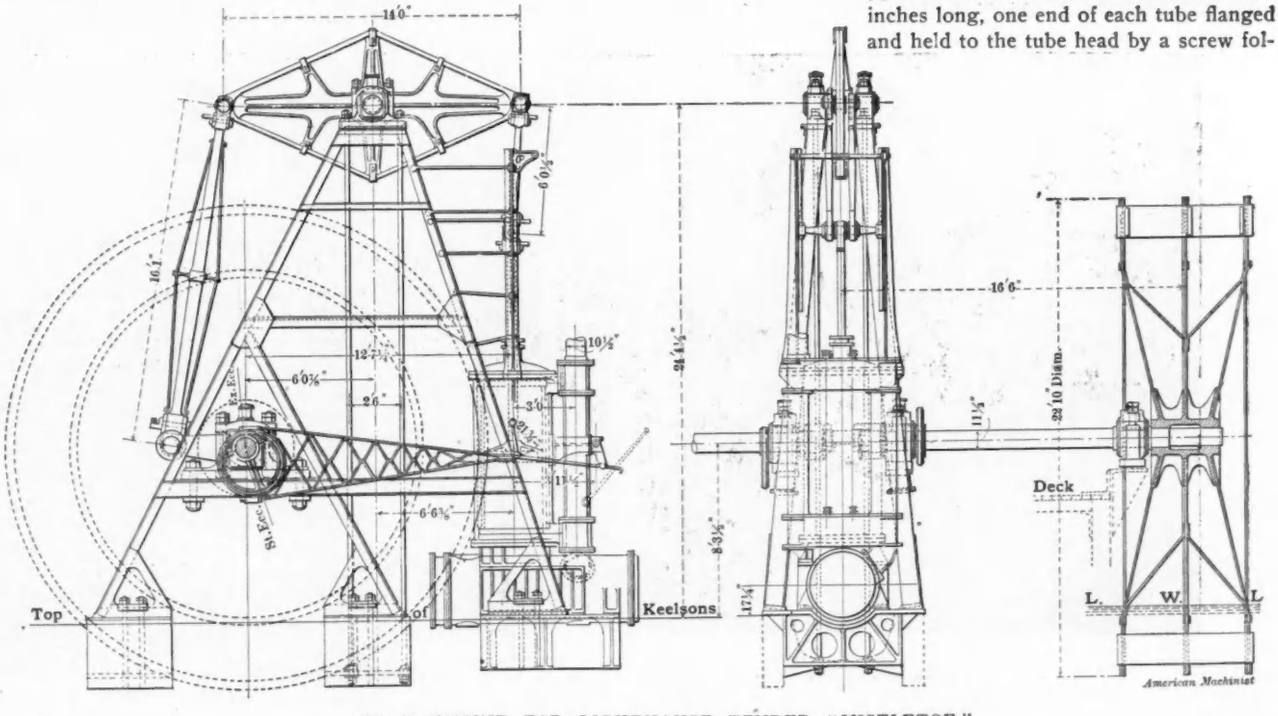
As the die holder automatically opens, the machine will thread spokes as fast as they can be handled by the operator. It is intended for threads up to ⅛ inch diameter. It is made by the Prentiss Tool & Supply Company, 115 Liberty street, New York.

Engine for Lighthouse Tender "Mistletoe."

On the opposite page we present to our readers a drawing of a beam engine for the United States lighthouse tender "Mistletoe." An engine of this type has not been illustrated and described, to our knowledge, in ten years, and the present opportunity would not have occurred only that the engine is designed to replace another engine in a boat which has already done many years' excellent service.

The dimensions of the hull are: Length between perpendiculars, 153 feet; beam, molded, 25 feet 11 inches; depth, 9 feet; displacement, 398.11 tons.

The cylinder is 33 inches diameter and 7 feet stroke, to run with an initial steam pressure of 97 pounds and at 31 revolutions per minute. The cylinder has a renewable liner, and the entire cylinder, cylinder cover and bottom are jacketed, then covered with magnesia sectional covering and black walnut lagging outside. Balanced poppet valves are used with liner seats for the upper valves.



BEAM ENGINE FOR LIGHTHOUSE TENDER "MISTLETOE."

The piston is of the inverted disk pattern, turned all over, with two cast-iron piston rings. The piston rod is to have a taper fit in the piston and to be ground in and secured by a nut recessed into the piston. The crosshead end of the rod is to have a connecting rod head, with straps and liners to secure it to the crosshead, and in the center an oil cup and suitable leaders to conduct the oil to the link pins. The connecting links will be 6 feet ½ inch center to center.

The walking beam, 14 feet between end centers, will be of cast iron, with a forged mild steel strap, finished all over, and fastened by keys and wedges. The connecting rod, 16 feet 1 inch center to center, will have bronze boxes lined with babbitt for the crank end, and bronze without the babbitt for the beam end.

The shafts will be of steel 11½ inches diameter, with cranks shrunk on and keyed, and the paddle wheel ends keyseated flat only. The crank pin will be fixed in one crank only, and secured to the other crank by an adjustable device.

The valve gear is to be of the usual steamboat type, with steam and exhaust rock shafts and wipers.

A Worthington surface condenser will be used, with 1,400 square feet of cooling surface. There will be 993 brass tubes, ⅝ inch outside diameter and 8 feet 10½ inches long, one end of each tube flanged and held to the tube head by a screw fol-lower, the other end passing through a gland packed with corset lacing, a baffle plate distributing the steam as it enters.

The air pump provided will be a Worthington duplex wet vacuum pump, with steam pistons 7½ inches diameter and air pistons 10¼ inches diameter by 10-inch stroke.

The circulating pump will have two

9-inch steam pistons and 12-inch water pistons by 10-inch stroke.

There will be a duplex feed pump, with 6-inch steam pistons and 4-inch water pistons, and also an injector.

The boat will also be provided with an independent bilge pump and steam steering gear.

The boiler will be of the Watkins & Dickson marine type, 11 feet across the front, 14 feet long and 12 feet high at center of front, with 2,314 square feet of heating surface, provided by 174 3-inch fire tubes 8 feet 6 inches long and 48 3½-inch water tubes 13 feet long. The boiler is to have two furnaces, each 55½ inches wide, 78 inches long and 60 inches high over the grate-bars at the center, each furnace opening out into a corrugated flue 39 inches diameter and 4 feet long.

The boiler is to have a hydrostatic test to 150 pounds continued until no leaks appear, and is then to be tested with steam to 110 pounds continued long enough to show that it is in absolute working order.

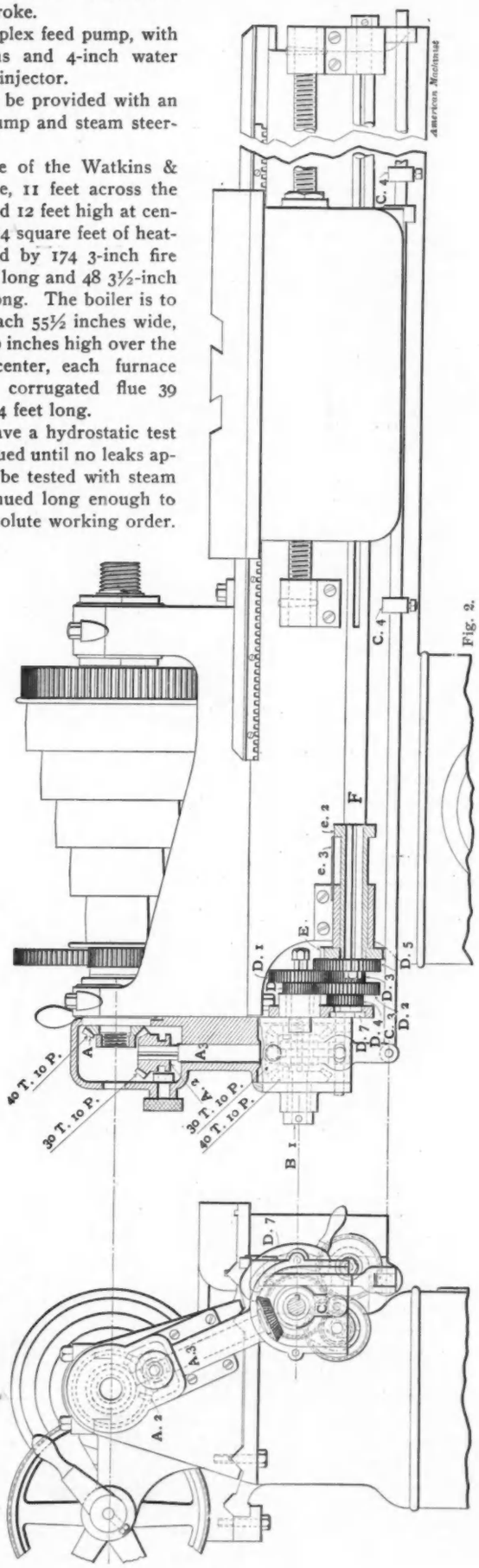


Fig. 1. MECHANISM FOR DRIVING THE FEED ROD. Fig. 2.

Lathe Feed Mechanism.

Machinists are naturally always interested in lathe improvements, and we now present engravings of a lathe which has several novel features. The lead screw does not revolve; the change gears are fixed within the apron, and motion is imparted to them by a train of gearing which also possesses some new features.

Figs. 1, 2 and 3 show this train of gearing for giving motion to the feed rod. On the rear end of the live spindle is a bevel gear A, which drives the inclined shaft A^3 by means of the sliding bevel gear A^2, this gear being moved up or down, to connect or disconnect the feed train by the knurled knob seen at the left.

At the lower end of the inclined shaft A^3 is a bevel gear which drives two others in opposite directions, these running loose on shaft B^1, and arranged so that either of them may drive it by means of a double-end clutch, as shown in Fig. 2. This clutch is arranged to be thrown by the rod c^3, on which are adjustable tappets with which the carriage comes in contact at any desired point, thus automatically stopping the feed in either direction, whether the feed be by the apron gears and rack, or by the lead screw and nut.

Keyed to shaft B^1 are gears D and D^1, which engage and drive gears D^2 and D^3. These last-named gears are on sleeves which run loosely on a stud fixed in a swing plate D^7, as more clearly shown in the enlarged view, Fig. 3. Keyed to gear D^2 is gear D^4, and to gear D^3 is keyed gear D^5. Gear E can be driven by any one of these four gears, and consequently at four different speeds, gears D^2 and D^3 acting as intermediate from D and D^1, respectively, while D^2 and D^4 act together as compound gears, and gears D^3 and D^5 the same.

Gear E is keyed to a sleeve which slides through the feed-rod box and is splined to the rod. On the other end of this sleeve is a knurled knob by which the sleeve is adjusted endwise, and the position of this knob with respect to the table e^3 shows what threads are cut with the change lever (to be hereafter described) in various positions; also the various ranges of feeds, all as shown by table, Fig. 3.

When threads are to be cut outside the range of the gears described the sleeve with e is slipped to the right as far as possible, as shown in Fig. 2, thus exposing the end of the feed rod, which is adapted to receive any change gear in the ordinary manner, which change gear can then be driven by a gear placed at the right-hand extremity of stub B^1, gear D^5 being then used as an intermediate.

Thus, provision is made for driving the feed rod at any one of four regular speeds, or at any desired special rate, and it is the office of the carriage mechanism to transmit from this feed rod motion to the

change gears; which, as shown at Fig. 7, are all keyed to a sleeve which runs freely upon the lead screw.

Sliding on the feed rod is a sleeve F^1 (Figs. 6 and 7), which has rack teeth cut across one side of it, as shown, and can thus be moved endwise within the carriage apron by turning the knurled knob F^6 (Figs. 6 and 8); graduations on the hub of this knob showing which one of the group of change gears will be engaged by an intermediate tumbler gear, which is supported upon a stud passing through an arm F^1 (Fig. 7) and is driven

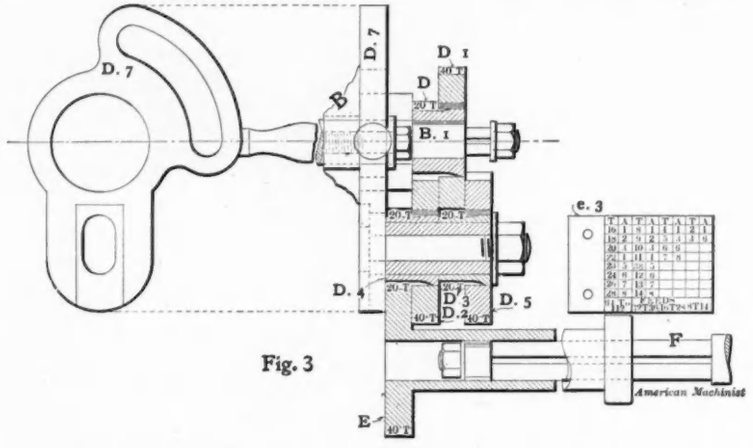


Fig. 3

by the gear F F, which is splined to the feed rod and is moved endwise upon it with the sleeve F^1. The intermediate F^9 is held in proper engagement with any given change gear, by the engagement of the hub of knob F^6 with the corresponding one of a series of notches upon the apron, shown at F^8, Fig. 8, and the hub is held in engagement with these by the helical spring shown behind the pinion. The same movement also causes the pinion to lock itself in position, by means of clutch teeth with which it engages, thus preventing endwise movement of sleeve F^1 until the knob is again pulled outward.

The change gears are all keyed to a sleeve G^1, which passes freely over the lead screw and runs in a bronze bearing I^5, Fig. 7, at each end of which is a hardened steel washer G^3 and G^4. These can be adjusted to take up endwise play by the nut G^2, which is outside the carriage at the right; and, passing through an enlargement of this sleeve, at the left, are wedge-shaped pieces of bronze G^5 (Figs. 5 and 7), which form the lead-screw nut and are opened and closed upon the lead screw by the endwise movement of the collar G^6, which collar is moved by the crank handle g^{10} (Fig. 5), through the medium of a rack and pinion, shown also in Fig. 4, where, at the left, is shown the means of preventing the nut and the rack feed from being engaged at the same time. In the position shown in Fig. 4 the nut is engaged, and the tumbler plate H^4 is held in such position that the train of apron feed gears is necessarily disengaged, and cannot be again engaged until the rack is moved to the left, thus opening the nut.

The train of apron feed gears is arranged about as usual, and is driven from the bevel pinion I^3, which is on the end of the sleeve to which the feed gears are attached.

Knob H^3 (Fig. 8) clamps the carriage to the bed by the movement of the wedge shown at the right.

The drawings are for an 18-inch lathe and show an unusually elaborate construction, the necessary expense of which is believed to be justified by the ends attained.

It is the design of W. L. Schellenbach, 307 Broadway, Cincinnati, O., and he has recently been granted patents upon it.

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Brussels Exposition.

We have received from the United States Commissioners to the International Exposition to be held in Brussels next year, pamphlets explaining the matter in full. We do not feel justified in taking space in these pages for details, but advise those who may be interested in Belgian trade and its development to write to the commissioners for particulars. The commissioners are Prof. J. H. Gore, of Columbian University, and Thos. Wilson, of the United States National Museum, Washington, D. C.

▲ ▲ ▲

A feature of the recent Election of interest to machinists was the use for the first time in a National Election of two varieties of voting machines. The Myers machine was used in Rochester, and though some difficulty arose from the necessarily great haste with which the machines were prepared for use, this difficulty was found mainly with the doors and their fastenings leading to the voting compartments, and not with the machines themselves, which are reported to have enabled voters to record their choice faster than those in charge of the polling lists could verify names of voters. The principal advantage of the machines was shown, however, in making up the count, which was done very quickly, owing to the fact that the machines recorded the votes as cast, and it was necessary only to read the totals from them at the close of the voting, the result being that the figures for the city of Rochester were known in New York much earlier than from other places similarly situated. In Worcester, Mass., a machine was used which perforates a paper to record the voter's ballot.

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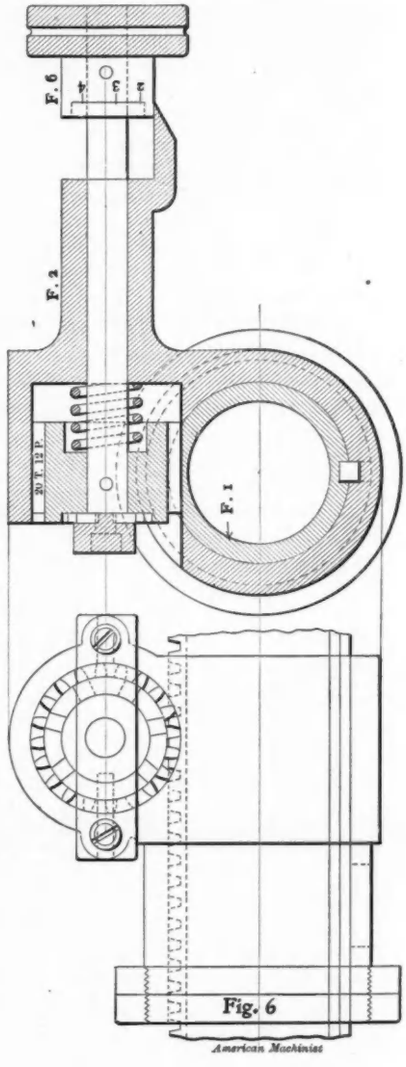
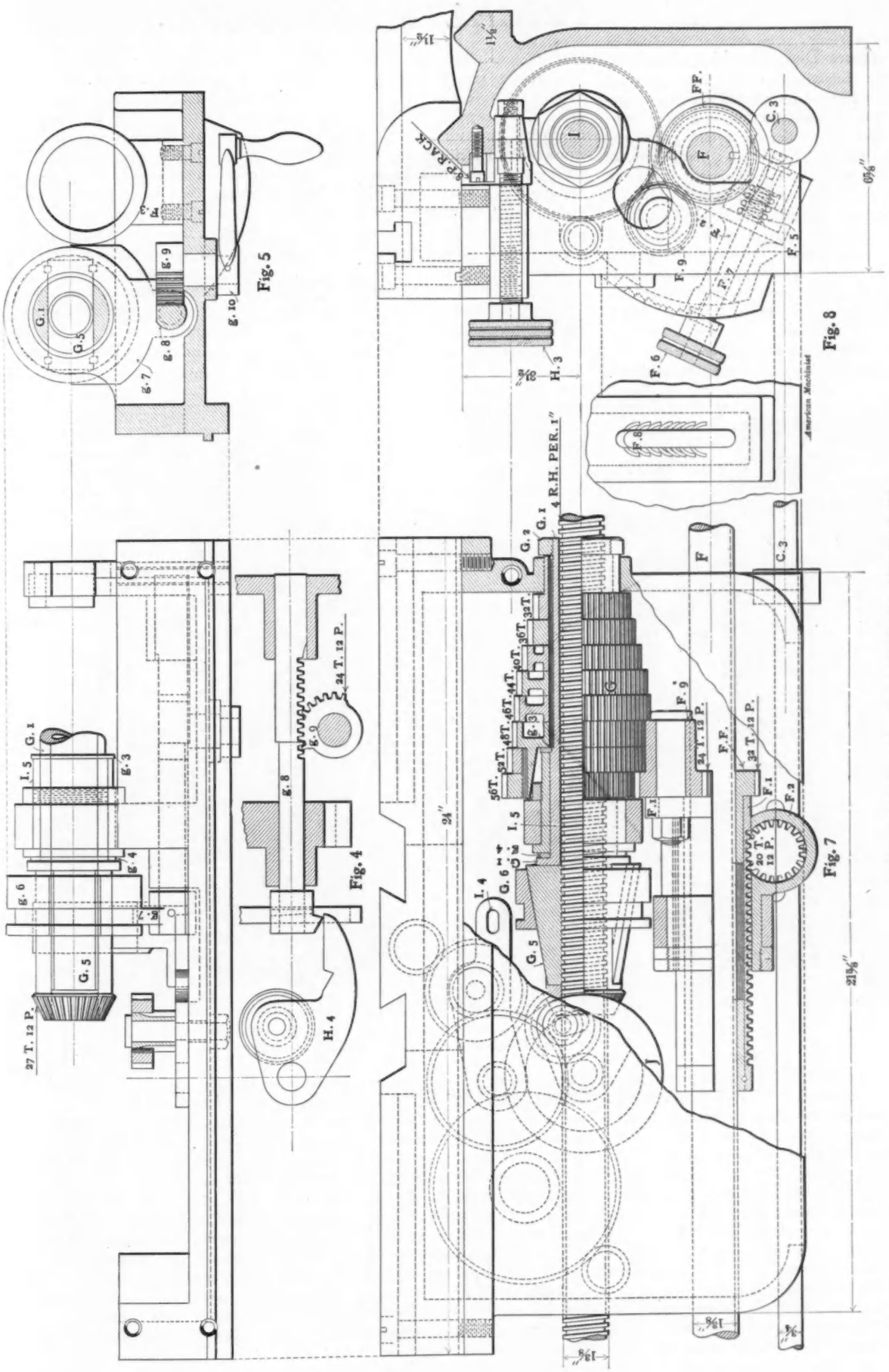


Fig. 6

A correspondent is in search of a material from which a flat spring about 1 inch long by ¼ inch can be made, and which will retain sufficient elasticity to hold and push back a point that will come against it at every revolution of the machine, the spring to be subjected to considerable heat—sometimes to a low red heat. Do any of our readers know of such material?

▲ ▲ ▲

The great overshot water wheel at the Isle of Man (72 feet 6 inches diameter, and the largest in the world) was erected in 1854. About $750 was spent in strengthening it a few years ago, which sum is said to be practically all it has cost for repairs since its erection.



CHANGE GEAR AND TRANSMITTING MECHANISM.

ELECTRICAL MACHINERY.

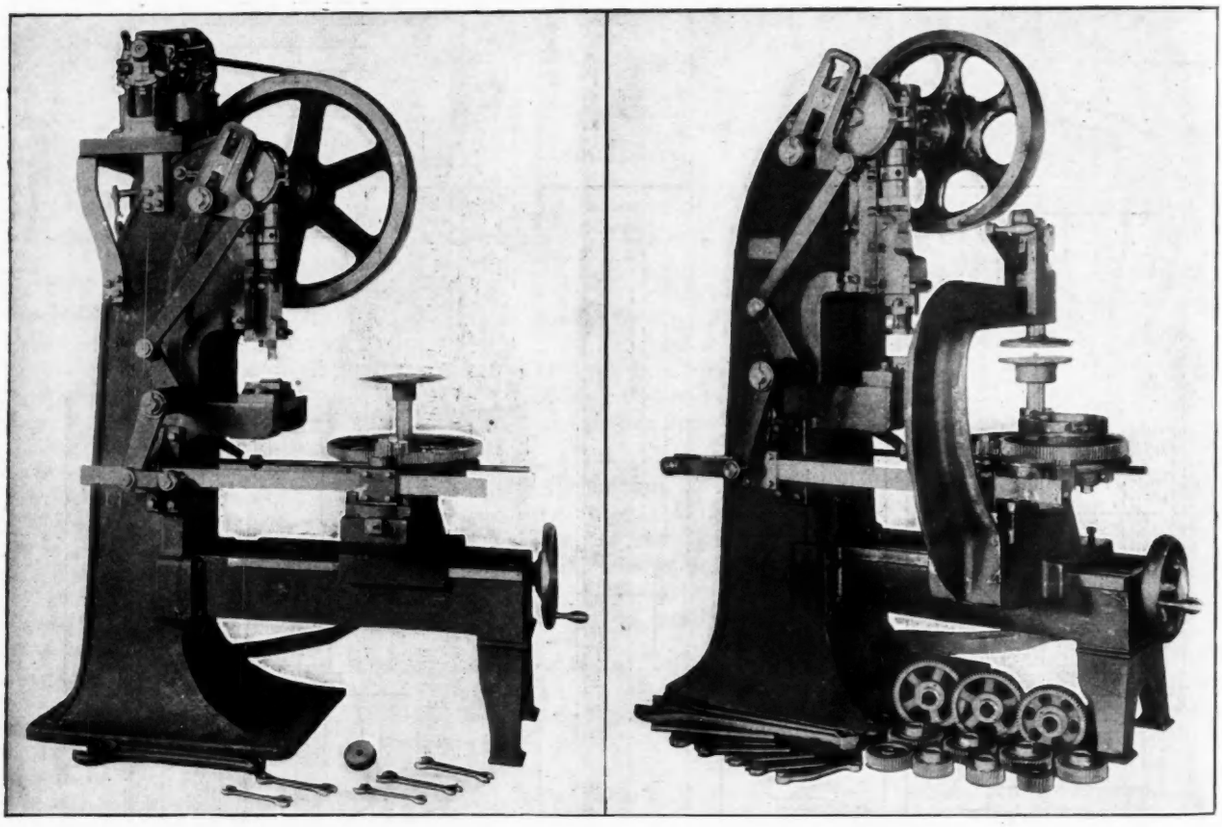
Armature Disk Notching Machine.

The introduction of the laminated grooved armature opened a new requirement for its construction on a large scale, as nothing similar to it had previously been made. The circular blanks are, of course, easily made in existing presses, and, in a few cases, the notches are cut at the same operation. To do this, however, requires expensive dies, and moreover, to punch large disks in this manner would involve presses of great size which, in view of the comparatively limited demand for large machines, would involve an expense beyond what would be justified. The use of the method of punching out the disk at once, complete with the notches, is therefore limited to those sizes which are in large demand, such as railway motors and other standard sizes in large demand.

For the great majority of sizes, the blank disks are first cut out, and these disks are then mounted on a punch press with an automatic feed step-around attachment, by which the notches are punched out in succession. At first, as was natural, these machines were made up from existing regular patterns of presses, to which the necessary parts for the feed were attached, and such presses have done excellent work and lots of it.

In the progress of the industry, opportunities for improvement have come to the surface, and we illustrate this week a new machine designed by the E. W. Bliss Company especially for this class of work. The aim of the designer of this press was to facilitate the adjustment of the press for different diameters of disks and pitch of notches, to provide a cheaper arrangement of change gear for different sizes, and to quicken the taking-out of the finished disks and the insertion of the blanks.

In the older presses of the E. W. Bliss Company each diameter of disk and pitch of notch required a special index plate, and a good deal of lost time was involved in adjusting the machine for different disks, owing to the feed being accomplished by a pawl and ratchet acting on the index plate, which necessitated an adjustment of the feed at each change of either diameter or pitch. In the present machine the principle of the dividing mechanism is more like that of a gear cutter. Each arrangement of change gears gives a definite number of divisions to the circle, regardless of the size of the blank, and a change of gears is hence only necessary for a change in the number of notches. With the older plan, for example, three disks of, say 12, 15 and 18 inches diameter, but all having the same number of notches, would require three index plates; whereas with the present construction all would be cut with the same gearing. Moreover, the former change piece was an expensive index plate, whereas the present change piece is a simple gear wheel. By a further simplification, of the feeding mechanism, the change is reduced to a single gear, and this has the same number of teeth as the notches to be cut in the disk so that no calculation or reference to tables is necessary. This statement is subject to a slight and obvious modification for cases where multiple punches are used, cutting several notches at a stroke. If two or three notches are cut at once, the number of teeth in the gear is one-half or one-third, respectively, of the number of notches.



AUTOMATIC NOTCHING PRESS.

The feed is accomplished through the train of bell cranks and links, shown mounted on the column, which give a fixed movement to the horizontal sliding bar. This bar is, in fact, a rack, the teeth being upon the side away from the observer, and it gears into a pinion not shown. The movement of the rack is such as to give one complete revolution and back to the pinion, which by a rachet and pawl connection, imparts a movement in one direction to the train of feed gears. This movement is carried to the plate which carries the blank, modified by the

change gear to give the pitch of notch required. It will be seen that this movement of the first pinion is the same, regardless of what its position may be on the length of the rack, and the blank-supporting block may be cranked out or in by the hand-wheel shown, and thus be set for the diameter of the blank without altering the feed or requiring adjustment of the feed gear.

Fig. 1 shows a machine with an arm reaching around the blank, with a clamping device above it; while Fig. 2 shows a machine without this arm. The second machine is the one most frequently used for disks having driving or key notches on the interior circumference. Such disks are supported and turned to position by a simple plate, having a raised centering boss the size of the hole in the disk, and fitted with pins to engage the key notches. No clamping of the disk to the plate is necessary because of the spring stripper, shown in Fig. 1. This stripper grips the plate just before the punch reaches it, and holds it until the punch is again withdrawn, when the stripper is released and the plate is fed to the next notch. There is hence no disturbance to the plate while being punched, and no clamping device is required, which obviously facilitates the removal of the finished disk and the insertion of the blank.

In cases where the disk has no driving notches on its interior circumference, a clamping device is necessary, and the machine shown in Fig. 1 is employed. The clamping is done by a cam lever, as plainly shown, and the grip is sufficient, in connection with the spring stripper, to insure accurate spacing of the notches. This Fig. 1 also shows a brake which is used when punching large-size disks, to obviate the effects of momentum, as the feed is made very quickly.

The machine is provided with an automatic stop, by which its action ceases when the last notch is punched, which, together with the quickness of the changes, makes it possible for one operator to attend two machines.

The machine is driven by belt or electric motor, as may be most convenient, Fig. 2 showing a motor in position. The short belt is fitted with a spring-tightener pulley, which takes up the slack automatically.

The machine is made in three sizes, covering a range of disks from 3 to 60 inches diameter.

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The Utilization of the Lachine Rapids.

The Lachine rapids of the St. Lawrence River, near Montreal, are chiefly known to the general public through thrilling pictures of steamboats on their beam ends and pitching at an angle of forty-five degrees or thereabouts, and going apparently to inevitable destruction, but prevented from reaching it by an intrepid Indian pilot, who alone is supposed to possess the requisite nerve for the occasion. The actual running of the rapids is not up to the pictures in point of excitement, while the Indian pilot is a myth of the artist. The rapids bid fair in the near future to be of as great interest through their utilization for generating power and light as they have heretofore been for the supposed dangers of their navigation.

The construction of the works for turning the current to useful account began about a year ago, and is well advanced toward completion. The construction of the water power is simple, consisting of a wing dam for deflecting the water to be used, with turbine wheels for driving the electric generators. While the plan is simple, the work of construction is not, as considerable engineering difficulties have had to be faced and overcome. Owing to the low head (8 to 11 feet), unusual arrangements have had to be made. There are to be sixty-six turbine wheels arranged in eleven sections of six wheels each, the wheels of each section being geared to a common jack shaft, from which one generator is to be driven. Twelve 750 kilowatt generators are to be supplied, of the Canadian General Electric Company's make—the entire plant being expected to develop in the neighborhood of 10,000 horse-power, which will be carried to Montreal and used for the various purposes to which it is adapted.

This notable piece of work is the outcome of the efforts of two young men without means, but with a limitless amount of ability and pluck, who took up a scheme which had long been talked of, enlisted capital, and apparently have put it on the road to assured success. We hope their reward will be proportionate to their deserts. The enterprise is conspicuous among such from the fact that the speculative element has been ruled out. The public was not asked to come in until the enterprise had been backed by leading capitalists and its success assured, and the president asserts that not a dollar of commissions or stock has been given to any promotor or other parasite, such as fatten upon such enterprises.

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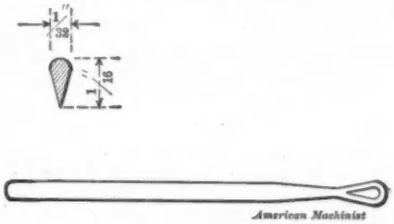
Letters from Practical Men.

Shop Oculists.

Editor American Machinist:

In a recent issue of the "American Machinist" I read with interest the article on "Shop Oculists," having followed that profession more or less closely for a number of years. I have been both operator and patient, with and without the use of cocaine, and I am ready to indorse its use on all occasions.

It often happens after a piece of steel or emery has been removed from the eye, especially if it was on the sight, that there is a good deal of inflammation and consequent scratching of the eyelid. A drop of sweet oil will instantly relieve this. If sweet oil is not available, good clean red machine oil will answer. Of course, care must be taken not to use low-grade machine oils, as they often contain acids and



A SHOP OCULIST'S INSTRUMENT.

alkalies, which will increase rather than allay the irritation. Recently I have used a tool like the sketch, instead of the knife blade, and find it an improvement when the light is not good. It was made of a piece of Stubs' wire about ⅛ inch diameter. The opening in the end of the tool is about $\frac{1}{16}$ x ⅛ inch, and a section of the semi-circular portion is given above.

SAMUEL H. RALSTON.

Perth, Ont.

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European Tests of Engines and Engine Designs.

Editor American Machinist:

The communication from Mr. H. Bollinckx, Brussels, in the October 15th number of your valuable journal, is interesting. It is, at the same time, misleading, for it seems to indicate that my criticism of transatlantic engines tests was aimed at him. While a reference, by Professor Sweet, to a test of Mr. Bollinckx' engine was responsible for my communication, I wish now to say that I had in mind the extravagant claims generally made by our competitors on the other side. The test cited by Professor Sweet seemed to give, from our standpoint, extravagant results, and the question arose whether such result could be obtained with our method of testing; that is, if tested precisely as the engine will run under commercial condition. I have quite as serious doubts since reading Mr. Bollinckx' article.

We acknowledge Mr. Bollinckx as an excellent designer and engineer; we concede to his engine all the good qualities which have made it justly famous in the European markets, and can assure him the fairest criticism when his engine is tested over here. At the same time we cannot refrain from expressing doubt, in all cases, when engine duty seems unwarrantably high. If, when any European engine is tested under precisely the same conditions our engine-builders meet, it proves superior, none will be readier than the writer to pay tribute in words of praise.

Mr. Bollinckx has kept well to the front in adopting all details which tend to engine economy; our builders have also

been progressive. Mr. Bollinckx has recognized the value of small clearance as a factor in economy; but it is doubtful if he has gone beyond our best builders in that direction. The interesting cuts which accompany his communication show how well he has jacketed his cylinder, and how studiously he has kept his clearance down. Our own builders have done quite as well, and one has put projecting plugs on the piston for the purpose of filling the ports in the heads. Mr. Corliss, long before his death, built engines with admission and exhaust valves in the cylinder heads, and Mr. Reynolds, of the Allis Company, has followed the same practice; many other builders have done the same.

Induction and exhaust through the cylinder heads have not been popular with us. In fact, it is only special engines which have been so constructed. Now, right here we see the radical difference between the American and European ideas of economy. We weigh all points which bear on this question, while our distant neighbors are inclined to sacrifice in the interest of fuel. This may be due to a higher cost for fuel, and may be warranted. But we cannot afford to consider coal only; we must count all costs aside from fuel; and among such costs one of the most important is that of delay from a broken or inoperative engine. The cost of repairs is usually small when compared with delay. The construction, or rather location, of Mr. Bollinckx' improved valve gear will not endear it to Americans, for the reason that it makes access to the cylinder and piston annoying and expensive; it also increases the possible delay due to accident or breakage. All will agree with him that reduced clearance means steam economy; but few will be willing to accept slight gains at the expense of convenience.

HARRIS TABOR.

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Finishing Cast-In Crosshead Wrist Pins.

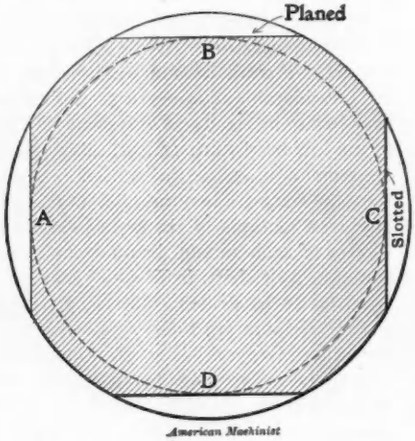
Editor American Machinist:

In your issue of October 15th, Mr. Charles P. Paulding gives his opinion as to what is the right expression for the efficiency of a hydraulic ram. I am inclined to agree with him, that the expression given by Rankine is the correct one. The second expression which I gave in my previous letter is, however, used by some authorities, and is, I believe, the expression adopted for use in the mechanical laboratory of Cornell University.

I was much interested by Mr. John Randol's description in your last issue of a "crosshead wrist-turning trap." Some years ago, while working in a railroad shop, it fell to my lot to chip and file a large number of cast-in wrist-pins, and a more trying, laborious job I never struck. A considerable saving in time can be effected in such a job, and the accuracy of the work be made greater, by first planing and slotting the work as shown in sketch, where the dotted line shows the finished pin in section. The points *A*, *B*, *C*, *D*, being on the circumference of the finished pin, serve as guides in the chipping.

The pin for the best service should be made slightly elliptical, with the long axis of the ellipse in the direction of the piston rod of the engine. A slight flat chipped on top and bottom aids in distributing the oil over the bearing surface.

While recognizing the advantages of a pin cast solid with the crosshead, it would be well to bear in mind the great advantage that a fitted pin has in the fact that it



can be made of harder and stronger material than the crosshead. A wrought-iron pin, case-hardened, or a pin of moderately hard steel, will give excellent service, and at any time may be removed and trued up in a lathe or grinding machine at very small cost.

R. E. CHANDLER.

Ithaca, N. Y.

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Computing Angles.

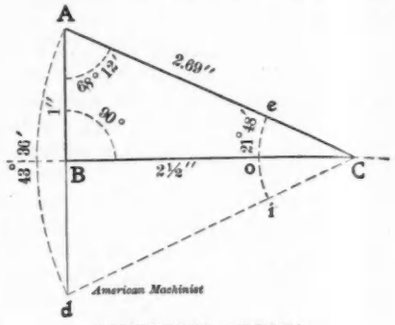
Editor American Machinist:

In Query 191, issue of November 5th, diagram explanatory of method of finding angles, as well as description thereof, needs revision.

Of course, you know that radius of a circle is the whole distance from center to circumference, instead of the lesser distance *B C* shown. The dotted arc *A d* should pass through *B*, making *A B* a tangent instead of a half-chord; then height *A B* divided by base [radius *B C*] gives tangent of angle *A C B*, where radius is 1. We would then have $1 \div 2\frac{1}{2} = 0.4$, the tangent of 21° 48′, and the angle *B A C* 68° 12′.

CHARLES E. CHURCH.

[We have to thank our correspondent for calling our attention to our absurd use of our own diagram and to the incorrect results attained. We reproduce the diagram with the figures for the angles corrected. We certainly know, since the Election is over, that the radius of a circle is the total distance from the center to the circumference, or, in the diagram, the radius is *A C* instead of *B C*. As *A B* is 1 inch and *B C* is 2½ inches, then *A C* is



COMPUTING ANGLES.

$\sqrt{1^2 + 2\frac{1}{2}^2} = 2.69$ inches, and 2.69 : 2 :: 1 : .7429, which is the ratio of the chord *A d* to the radius *A C*. By the table of chords we then find that the corresponding angle for this ratio is 43° 36′, and one-half of this is 21° 48″ for the angle *A C B*, and consequently the angle *B A C* is 68° 12′, our results being now identical with those of our correspondent above.—Ed.]

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The Striking Force of a Sledge.

Editor American Machinist:

With your kind permission, I would like to correct your answer to C. C. S., in the issue of November 5th of your valued paper.

You state as the average force of an 18-pound hammer blow, 1,431 pounds; that is, you have divided 143.1 foot-pounds by .1 inch. It should be, of course,

$$\frac{143.1 \text{ foot-pounds}}{\left(\frac{.1}{12}\right) \text{ foot}} = 17{,}172 \text{ pounds.}$$

I would suggest a simpler way. The energy of a body is equal to the weight multiplied by the height it can fall:

Let W = weight = 18 pounds;
h = height = 4 feet;
Wh = energy = 72 foot-pounds.

The energy of the resistance equals the amount of the resistance multiplied by the distance through which it acts:

Let R = resistance;

$$s = \text{distance} = .1 \text{ inch} = \frac{1}{120} \text{ foot};$$

$$Rs = R \text{ pounds } \frac{1}{120} \text{ foot.}$$

The energy of the resistance must balance the energy of the body or hammer:

$$Wh = Rs;$$

$$72 \text{ foot-pounds} = R \text{ pounds } \frac{1}{120} \text{ foot};$$

$$R \text{ pounds} = 8{,}640 \text{ pounds.}$$

Now, if we say the man exerted a force equal to that of gravity, the average resistance of the material or the average force of the blow = 8,640 pounds × 2 = 17,280 pounds.

The difference in the two results is caused by not using the same value for acceleration due to gravity in the two formulas, in deducing the first result. In computing the velocity, its value was called 32; in finding the energy, it was called 32.2. And further, since the resistance

was nothing at the instant the hammer touched the material, and we may assume safely that it increased uniformly till the hammer was stopped, the average resistance must be one-half of the resistance when the hammer stopped, which is evidently the weight it will sustain. Its numerical value is $17,280 \times 2 = 34,560$ pounds. That is, the surface of the material where the hammer struck will bear, without crushing, a weight of 34,560 pounds concentrated on the surface, and evenly distributed over it, equal to the surface of the face of the hammer. A factor of safety should, of course, be used in practice.

W. M. W.

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Special Lathe Chucks.

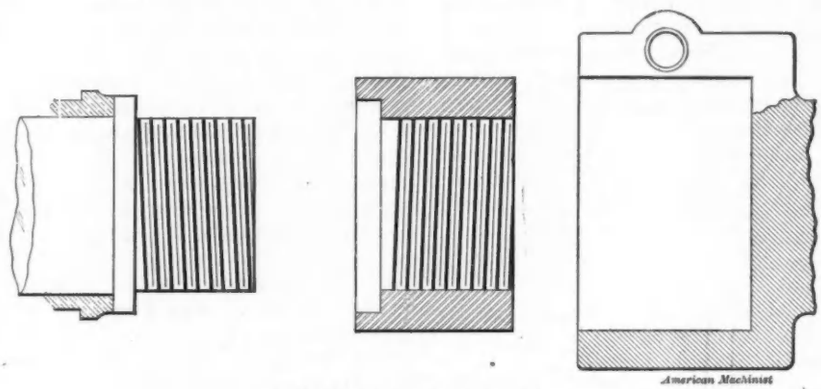
Edior American Machinist:

The best product and the largest output is always secured by special tools rather than by universal ones. An ordinary lathe chuck will hold a great variety of work; so will a face plate with an assortment of bolts and straps. Neither can compete with a special chuck made to hold some particular piece, providing this piece is made in sufficient quantity. Many times special chucks might be employed to advantage were it not for the expense of fitting each one to the spindle of the lathe. Even when so fitted, chucks are not as readily changed as is desirable. Mr. Halsey's article on a "New Lathe Chuck," in your issue of October 8th, shows a thorough appreciation of the advantages of cheap special chucks, and for some work it is hard to see how the simple design he shows can be improved.

For work upon which any heavy cuts are to be taken, the form shown in the accompanying sketches has the advantage of less overhang. The cut shows it applied to the spindle of a Jones & Lamson "flat turret" lathe, a place where its good points are even more conspicuous than on an engine lathe. It is simply a ring of steel fitted to the lathe spindle, the chucks being made to slip over and grip this ring. I have used chucks of this form for several years on work that would be very expensive if held by the usual method, but is cheaply done by their use. Their cost is little if any more than for the form shown by Mr. Halsey. The pattern for the portion of the chuck shown in the cut is made once for all, and patterns made for the different fixtures are attached to this pattern to be molded, so it is not necessary to make a complete pattern for each chuck. The work may be brought as close to the end of the spindle as is possible, and this, while securing rigidity, should also make it easier to keep the chucks running true; for, of course, the farther they project, the more any inaccuracy is magnified.

E. J. ARMSTRONG.

Oswego, N. Y.



A SPECIAL LATHE CHUCK.

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School Draftsmen.

Editor American Machinist:

The article in your issue of October 29th, regarding "School Draftsmen," possessed much interest for me, and I read it several times. The subject touched upon is one of vital interest, and justifiable criticisms are very sure to produce desirable results.

Regarding the young man who "had learned more in three months' experience (in the shops) than in the entire year at school," let us place him on a pedestal and throw shot at him to see if it is possible to pierce his armor; not for the purpose of injuring him, but to bring to light the defects of either the school or the shop system of drafting.

Let us compare the number of hours the young man employed in both places: In the office of the shops he worked 3 months, 8 hours per day, excepting Saturday and then only 5—thus putting in 580 hours. In the school he put in about 7½ hours per week, and during a school session of 40 weeks, 5 days to the week, he put in 300 hours; which is about what the average school gives per session to its engineering students in strictly mechanical drawing. Other things being equal, then, the average drawing apprentice should be more expert with the instruments than the average student.

As to his preference for the shop office —in the average school the engineering students are required to arrange the different views or sketches with nicety regarding the margin lines and to each other, while in the shop office the different views are generally slapped anywhere on the paper—of course, with due regard to the center lines. The average student is given, at times, problems relating to one view or two, and from which he must solve the third or more; while the drawing apprentice is given copies which bear alterations, or such like, from which to make others. The work of the school drawing-room is constantly changing; that is, as soon as one sort of drawing is completed, another is given, bringing in new principles. With the drawing apprentice his work is likely to be the same for weeks at a time, and his brain is not being constantly worried trying to find or learn (to him) new principles. In the class-room the student does not have the freedom of chatting with his brothers, nor the chance for observation through the different works, as does the other. Now, all of these matters being duly considered by our young friend, he concludes the drawing office, and not the class-room, is the place for him, and a dislike for the latter generally grows in him. If the young man was allowed to draw just what he wished, when he wished, and as long as he wished, while at school, I venture to say he would pronounce the school a grand success. How many students, if they were allowed to have their way, would puzzle their brains over problems on the intersections of solids and such? Still we know how important these are.

As an expert with the pen, as regards speed and nicety of execution, the young man is very likely ahead of those who have only attended school; but there are very serious doubts as to his ability as an all-round draftsman being anywhere near equal to that of a technical student who has done an equal number of hours' work in the class-room.

But enough of the young man, and something more general on the same subject. Some time ago I inspected some curious-looking drawings sent out from a place where quite a number of draftsmen are employed, and was much surprised to see the different views of the same piece quite a distance apart, and between them were placed views of entirely different pieces. The draftsman who did this was not a technical school graduate, nor would such practice be tolerated in any school.

It is my fortune to be acquainted with two graduates from the drawing-room of one of the foremost engineering establishments in this country. One of them is 36 years of age and the other 24. The older, for eight years after his apprenticeship, drew regularly $1.75 per day from one firm, and is now getting $2.25 from the same firm. It should be quite interesting to know how many technical school graduates have worked anywhere near that length of time for that money.

The 24-year old graduate is getting $1,500 per year and is quite an expert draftsman; but I heard him confess that he was far behind a technical school graduate of his acquaintance, as an all-around draftsman.

Not a great while since the just-mentioned establishment requested the resignation of two first-class draftsmen (graduates of the establishment), who had been with them for about fifteen years. In their stead was placed a technical school graduate at the paltry (?) sum of $3,000 per year—being more than the sum of the salaries of the other two.

Referring again to the article in the "American Machinist," I quite agree with the spirit of the article, and see no good reason why the schools should not turn out better draftsmen. One of the main ideas in the schools seems to be that of educating the students to be professors, authors, or walking encyclopedias, and the commercial side seems entirely lost sight of. Some day our college people may awake to the fact that perhaps one or two of their graduates may have to come down to hard work over the drawing-board and mix with the common herd, as all the "bossing" positions may be filled just at the time of graduation. Not enough prominence is given to those studies that are of most value to the engineer; but much valuable time is wasted on such as perspective, shades, shadows, on letters that would never be permitted on the drawings of any establishment, and in accuracy where it is not necessary. And above all, not enough time is given to drawing in the average school, although some of them are taking hold of the matter; as in looking over the catalogs, I noticed eighteen hours per week being given, which is certainly a step in the proper direction.

HARRY GWINNER,
Asst. Prof. of Mech. Eng., Maryland Agricult. Col.
College Park, Md.

[The young man whose experience forms the subject of this discussion, did not express a preference for the shop office over the school because it was easier or more agreeable, but because he had "learned more." We think the assumption that work in a shop office is less exacting, either physically or mentally, than that in the school-room, will scarcely be acquiesced in by most of those who have had experience in both.—Ed.]

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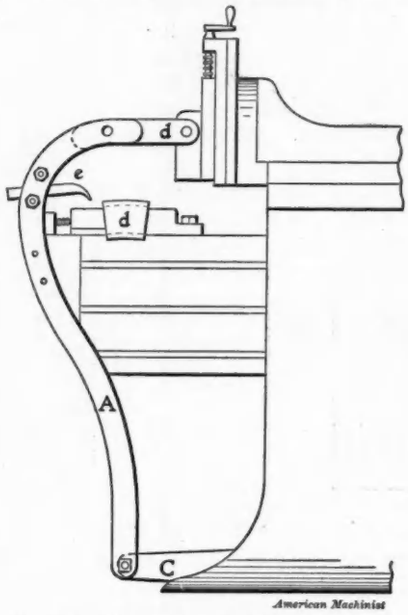
The Ethics of Criticism—Shaper Guides—Device for Shaping Link Blocks.

Editor American Machinist:

I notice that Mr. F. C. McClary, in discussing the relative merits of shaper guides in your issue of October 8th, invites an expression from others on this subject.

It is not only a privilege, but the duty, I think, of the practical machinist to point out defects in the construction of machine tools, and to suggest improvements when they occur to him. But to do this in such a way as not to give offense, seems to be the difficult part of it. It is clear that we should not expect to make the "American Machinist" a mouthpiece when what we may say points to some reputable manufacturer, perhaps, and is calculated to do him an injury. Even when an effort is made to criticise in a general way, it is often difficult to conceal the identity of the machine in mind, and as a result some person's toes are tramped upon. It is right enough for you, Mr. Editor, to disclaim responsibility in such cases, but that does not relieve the contributor from embarrassment when he has made a mistake of this kind. If, on the other hand, he has a word of praise for some well-known maker, there will be some who are ready to accuse him of jobbery in the way of free advertising in the interest of that person. The ethics therefore involved in such discussions often deter from freely referring to defects sometimes apparent in new tools, but more frequently those that develop by use.



DEVICE FOR SHAPING LINK BLOCKS.

For more reasons than one I was much interested in what Mr. McClary had to say about shapers. I think the usefulness of this little machine is sometimes underrated, for work is frequently taken to the milling machine which properly belongs to the shaper, as it could be done with sufficient accuracy and quicker on this machine. Especially is this true in shops where a general line of work is done, usually embracing a great variety, and but few parts of a kind at one time.

In choosing between the square and V-guides for a shaper ram, I, too, prefer the square, for the reason that this form, it seems to me, admits of less vertical motion in the ram for a given amount of wear. The makers of other forms, however, may rightfully insist that no lateral play should be allowed in the ram, and unquestionably the wear may be taken up as easily in one form as another. If I were to accept the V-slides I would insist on more wearing surface than is usually given to the angular sides. I can see nothing in the "wedging up" of the latter to object to.

While on this subject it may interest some of your readers to describe an attachment which I recently made to a shaper, that enabled me to plane the curved sides of a set of link blocks, a thing I have never seen done in this way before. Briefly, this device consisted of two bars of iron 2½ x ½ inch, shaped as shown at *A*, Fig. 1. They were attached to the ram-head by a short connecting piece *a*, and pivoted to an attachment *c* at the base of the machine. The link block *d* was held by the vise on the machine platen, and raised or lowered to secure the desired radius for the curves. The tool *e* was clamped between the bars in a proper position to cut on the upper or lower side of the block, as desired. The connection *a* was made to extend about 6 inches between the bars *A*, in order to prevent lateral movement of the tool while at work. The blocks were, of course, roughed out in the usual way to nearly their proper size, so that it required but little cutting to secure the desired form. Although the rig was crude, it answered a good purpose in the absence of a better method.

QUIRK.

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That Thread Tool.

Editor American Machinist:

I was very glad to see the letter by Mr. H. R. M. Gregor, in your issue of November 5th, about that thread tool. It gives us some additional information with regard to the tool, and it serves to keep open a subject that might be discussed much more fully with profit to a great many of us. If I offer to say a few more words on the subject, I hope it will be understood that it is not at all for the purpose of showing that I am all right and that someone else is all wrong, but that I at least may learn something and be more right afterwards than before.

As we have so much information about this interesting tool, could not Mr. Gregor kindly give us a little more? We make quite a mistake, it seems to me, when, in discussing the shape and action of metal-cutting tools, we have so little to say about the chips that are made; and if Mr. Gregor could send to the "American Machinist" some samples of the chips as they actually occur when the scooping-out process on the top of the tool is going on, the pictures of the steel wool and shavings on the page opposite Mr. Gregor's letter show that the editors can command the means of very graphically reproducing them. Many of us would be glad to see them, and I have no doubt we would be pretty sure to learn something from them.

Mr. Gregor says that if their experience

had shown that a tool ground differently would have cut better, they would, of course, have adopted the better shape. Unfortunately, lots of excellent mechanics, and successful mechanics, hestitate about pushing their experiments far enough to get any very wide experience, and in this case it seems that the necessary experience was barred by the assumption that being a "thread" tool it must therefore be ground flat on top. Grinding the tool flat on top might be all right enough if it did not also mean that the flat top should be radial to the work, or at right angles to the periphery of it. The section of the tool, with the wear on the front of it, shows that in this case the cutting face of the tool was practically radial, and it is no wonder that the tool should also show, as it did so plainly, that the work of severing the chip from the stock actually caused less abrasion of the tool than the work of rolling up the chip and diverting it out of the way. To my eye, the tool mutely appeals in the most convincing way for a more acute cutting angle, or for an inclination of the cutting face to the surface cut, so that it would more easily turn the chip.

It may be theoretically true that a tool to cut a thread of perfect section must be first ground accurately to gage, must have a flat face, and that the face must be set radial to the cylinder to be cut. This will apply, however, rather to V-threads than to square threads; but in an extensive experience in cutting all shapes and sizes of screw-threads in the lathe, I cannot remember that I ever actually tried it, and I am very certain that if I had ever tried it I would have found little encouragement to continue the practice. For any screws in iron or steel, it is always best to give the tool more or less "hook," and in the case of V-threads the tool may be ground to a somewhat more acute angle than the gage to compensate for the angle of the cutting face.

This matter may be treated graphically, and only two or three simple marks are needed to bring any man with any mechanical instincts to appreciate the situation. Suppose the tool to have a flat face, as Mr. Gregor says that most thread tools have, and that the face is radial to the work, as in Fig. 1. The sketches are purposely exaggerated. We suppose the tool to be feeding in endwise. The chip, of course, cannot possibly give in any other direction but outwards from the cylindrical surface, and we can easily realize how great must be the pressure required to make it do so. We usually think of chips as flowing or curling away from the tool, and it is evident that in this case the action could not be properly described by either of those words, and that is why I would like to see some of those chips. Although I suppose the steel is quite tenacious, I do not imagine that the chips would give much evidence of it. I suppose they would come out in very short snappy pieces, on account of changing their direction so suddenly, and it is likely that they would not show quite as much brittleness, or would not break off quite as short, after they had worn the groove in the face of the tool, Fig. 2, as they would at first. The sharpness of the actual cutting edge, as in Fig. 2, and as shown in the actual tool photographed, makes it seem quite plain that a more acute cutting angle might be employed, and that it would wear reasonably well. In Fig. 3 the angle of the cutting edge is more obtuse than that of the actual tool under consideration; but it is so set that the cutting face will certainly give the chip a hint of the way in which it should go after it is separated from the body of the metal, and will make it easier for it to go in that way than in any other. The angle of the front of the tool to the circular surface which passes before it should be as acute as possible, so that we gain something here also over the original tool.

The statement which Mr. Gregor gives of the weight of metal cut in a given time is interesting. Supposing the tool to be ½ inch wide, and to cut continuously, it would be equivalent to a chip about .03 inch thick; but if the screw is entirely finished in twenty hours, or if more than one tool is used at a time in the cutting, as I have an impression that there are, then, of

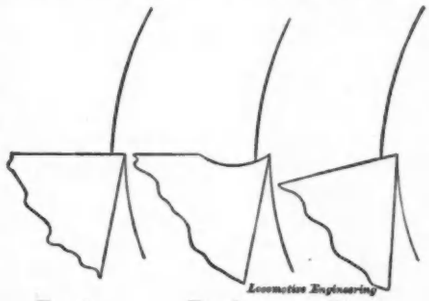

Fig. 1 Fig. 2 Fig. 3

ACTION OF THREAD TOOL.

course, the statement has an entirely different meaning and value.

Since Mr. Gregor has told us so much, I trust that he will kindly at least favor us with a sight of the chips.

MORRIS FULTON.

Philadelphia.

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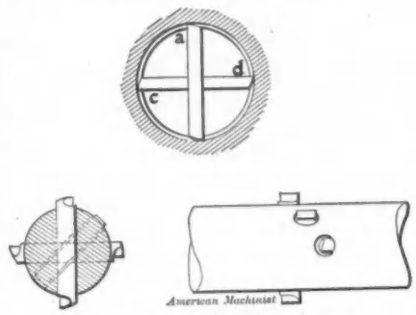
A Small Boring Bar.

BY C. O. GRIFFIN.

I offer herewith a sketch of a small boring bar which, for sizes to which it is adapted, is a more satisfactory tool than any with which I have had experience.

This tool is an outgrowth of experience with the four-lipped drill or end mill. As is well known, this tool, when started straight, will go straight—paying far less attention to crooked cores than any two-lipped drill, either flat or twist. Having a good many holes of considerable length (about 22 inches long by 3 inches diameter) to bore, which it was essential to have straight and in quantities which precluded any horse-hair feeds, it occurred to me that if four cutting edges insured a straight hole when applied to a drill, the same results should follow with four cutting points on a boring bar. The need of a tool which should pay no attention to crooked cores was increased in this case by the fact that experience had shown a great tendency on the part of the core to float in the mold, and so give



A SMALL BORING BAR.

in many pieces, a much heavier cut on one side of the hole than on the other. The bar has been entirely satisfactory under these conditions, the hole being made by a roughing and finishing bar of the pattern shown, followed with a sizing reamer; and with heavy feeds the holes come straight and good, passing a hardened and ground plug 12 inches long without any sign of being crooked. Multiple cutter boring bars are used with a view of increasing the output, but I do not think their property of making straight holes is recognized as it deserves to be; and from this point of view I believe four cutters are better than any other number, unless it be eight, and this for the reason shown in the upper sketch. With two cutting points only, if the cut at *a* be heavy, the tendency of the two cuts is to equalize one another, except as resisted by the stiffness of the bar. With four lips, however, any spring of the bar would cause increased pressure of cut at *c*, and decreased pressure at *d*, both of which actions resist the spring of the bar and tend to keep the bore straight. Furthermore, this action is better with four points than with any other number, except multiples of four.

The construction of the bar will be seen from the elevation and section. The cutters are made of short pieces of round tool steel, ground to shape without any fitting, and going through clearance holes in the bar. These holes are at right angles to one another, but sufficiently separated to permit a third hole to be drilled through the bar at an angle of 45 degrees with the cutter holes, and opening into both of them. A key goes in this third hole, and holds both cutters by forcing them apart. The whole arrangement will be seen to be very cheap, and further, it has one feature that I have not seen in other bars, in that the strain on the bar due to driving the key is a stretching force applied at the *center*

of the bar, and hence it has no tendency to spring the bar.

This arrangement of the tools should not be confounded with the one used in the expanding counterbore which you published for me in the issue of August 13th, and to which this has some resemblance. This tool is *not* intended for maintaining sizes, and should be followed by a reamer for that purpose. When the cutters are too far worn, they must, of course, be replaced.

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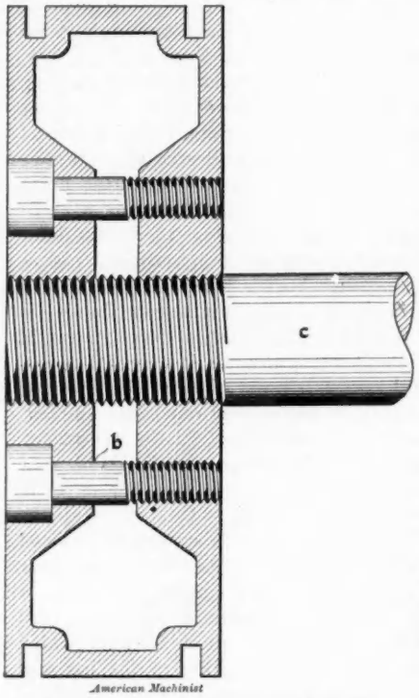
A New Piston-Rod Fastening.

In connection with the discussion which has occurred in our columns quite recently, as to the best mode of fastening a piston rod, the recently patented device herewith illustrated will be of interest, at least as to the piston fastening, and it may occur to some of our readers to find other applications of the same idea. The piston, it will be seen, is a single casting



A NEW PISTON-ROD FASTENING.

cored out, with the central hub entirely separated into the two portions attached to and forming parts of the two outer plates of the piston. A parallel thread is cut continuously through the two hubs, and the piston rod is threaded and nicely fitted thereto. The screws with heads sunk into counterbores in the outer plate of the piston and screwed into the inner plate, serve to draw the two plates and their separate hubs towards each other, and in this way to securely bind the piston rod. When the screws are slackened, the piston, or the rod, may be turned for the purpose of adjusting the rod to length.

This strikes us as a simple, cheap and yet effective device with the possible objection that the steam may leak by the thread; but this, of course, will depend largely upon the nicety of the workmanship. It is especially applicable to the pistons of tandem compound engines, and we are informed by Mr. E. J. Armstrong, the inventor, that it has been used upon engines built by the Ames Iron Works, Oswego, N. Y., which have been subjected to severe service for long periods of time and the fastening has been found to be in every way satisfactory.

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American Files in England.

The following we find in a communication addressed to "The Ironmonger," London. The most valuable and instructive part of it is, of course, in its suggestions as to the mode of attracting customers by constantly up-to-date goods:

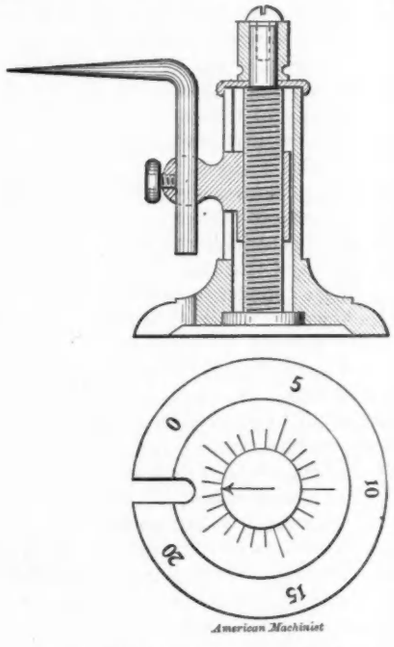
"There is no doubt that American files are finding a ready sale for use in this country, and also for export, which state of things should, I think, not be allowed to exist by the English File-Cutting Association.

"One of the reasons brought forward against the use of American files is that they are lighter than English ones; but, provided they do the work that is required —and there is a good deal of the class of work where light files can be used to advantage—then this objection cannot stand; and there should be no difficulty in the English file-makers turning out similar light files, which can be readily sold at relative prices to the heavy ones, and equally as cheap and good as those of American or any other manufacture. From what I hear, no fault can be found with the quality, and it is a great pity that trade should be lost in consequence of the Sheffield makers not moving with the times. A heavy file for heavy work is no doubt necessary, and a quantity will always be used, but where light files can be employed to equal advantage, and can be purchased at a considerably less price, then the users will and must study their own pockets.

"Of course, these remarks respecting foreign competition do not apply solely to steel files, but to numerous other articles which have been made in England in a certain manner, shape and size for very many years, and in which a good business has been done; but now we find, when changes to meet foreign competition are absolutely necessary to the welfare of the country in general, that many manufacturers are apt to err in insisting upon the adherence to these old manners, etc., whether their customers like it or not. It is this over-confidence, and, in some cases, I will say, conservative pigheadedness, on the part of the manufacturers which affords the opportunity to the 'obliging' foreigner to step in and carry away many orders from old and valued customers, which used to be considered an impossibility."

A Micrometer Surface and Depth Gage.

The interesting little surface gage shown on this page is merely one of the many tools in the kit of Mr. Chas. A. Seymour, of the Tolhurst Machine Works, Troy, N. Y. The gage needs little explanation. The central screw has a head at the bottom and is secured by a milled cap which also serves to turn the screw. The screw has 40 threads to the inch, and with the base of the gage graduated to 25 divisions the vertical movement of the gage is read to thousandths of an inch in the usual way. The sliding nut fitting the main screw projects out through the side of the column, and is provided with means for securing gage points of different shapes and lengths as required. The base of the instrument is slotted, so that points may project down beyond the base and enable



MICROMETER SURFACE GAGE.

it to be used as a depth gage. The gage is found very handy for laying out and scribing work upon a surface plate. The micrometer, of course, never indicates absolute measures; but when the point is set, and a mark has been made, and it is required to make another mark a certain distance from the first, the gage provides the means.

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Some experiments have been made at the Philadelphia mint with aluminum and aluminum alloys as token coins, but it is thought the metal will not prove satisfactory for this purpose, there being difficulty in rolling it into strips, and also some difficulty in annealing it.

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It is claimed that a reduction in fares from five cents to four would drive one-half of the best-paying electric railroads into bankruptcy.

The Blast System of Heating Without Distributing Pipes.

The system of heating factories by a forced circulation of air warmed by a stack of steam pipes, has become very popular during recent years. We present herewith ground plan and sectional elevations of a machine shop warmed by this system so far as blower and heating pipes are concerned, but without the distributing pipes—the circulation produced by the fan, unaided by piping, being found to be all that is required for satisfactory heating.

The shop in question is a new one, built about a year ago by the Jenckes Machine Company, of Sherbrooke, P. Q., Canada, and will be seen to be a large one. The total length of the building is 300 feet, of which, however, 20 feet are occupied by the offices, while the width is 97 feet. The shop is of brick, plentifully supplied with windows in the walls, as well as nearly continuous windows on both sides of the monitor roof. The framework is of timber, and the roof is of planks covered with metallic shingles.

It will be seen that, in size, the building affords an excellent test of the system, which is the more severe by reason of the climate in which it is located, where 25 degrees below zero is a very common winter temperature and 40 degrees is occasionally reached. We are informed by the Jenckes Machine Company that the results of the system, which has already had one winter's trial, have been entirely satisfactory, the shop being made warm and comfortable in one hour from the starting of the fans, when the temperature outside is at 35 degrees below zero.

The diagrams almost explain themselves, and from them it will be seen that the discharge of the warm air is through short manifolds attached to the discharge nozzles of the fans. These manifolds radiate in different directions, and are at the outlets slightly inclined toward the floor. The inlets to the fans draw the air from the floor, and thereby insure a positive circulation and a warm floor.

The section at *A B* shows a series of distributing pipes connected to a smaller fan and stack of pipes at the right, which are used for heating the offices. This fan draws its air entirely from outside the building, and return flues are provided, as shown, through which this air, after circulation through the offices, is discharged into the shop—thereby providing effective ventilation for the shop. This air is, of course, discharged at one end of the shop only, but the circulation produced by the shop fans renders it effective throughout the shop. To draw the air for the shop fans from outside would interfere with the circulation which is essential to successful heating, and would, moreover, provide an entirely unnecessary amount of air for ventilation purposes.

The heat is obtained entirely from exhaust steam and, of course, without cost.

In deciding upon a system of heating for a building, much, of course, depends upon individual judgment regarding conditions which cannot be expressed in rules; but in general this system is adapted to buildings containing large open spaces, and to those where there is no pronounced chilling effect at any one point, such as would be due to large doors frequently opened. Under some circumstances it is applicable to shops of the gallery type, and for all cases, except those of buildings composed of many small rooms, it seems to be demonstrated that a much smaller amount of distributing pipe is required than has heretofore been thought necessary.

In addition to the building shown, the system is applied, at the works of the Jenckes Machine Company, to the foundry and pattern shop, with equally satisfactory results.

The outfit was furnished by the Buffalo Forge Company, of Buffalo, N. Y.

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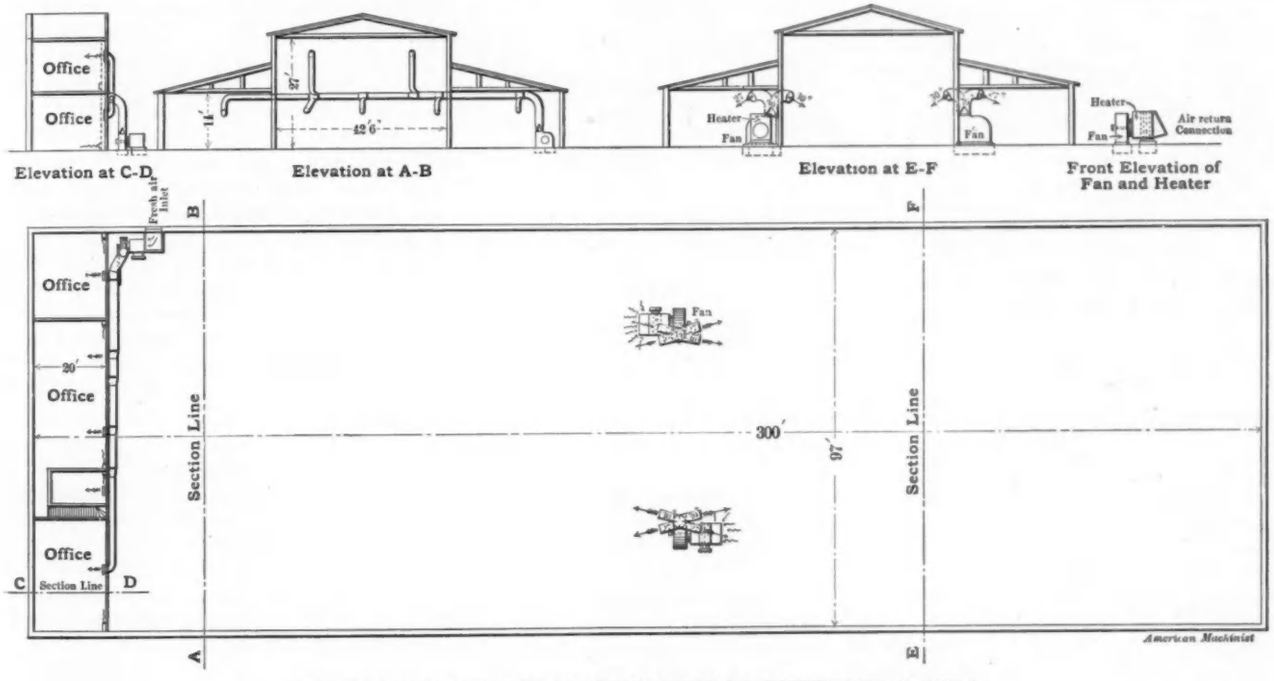
The Buffalo Forge Company, Buffalo, N. Y., recently received an order for an apparatus to be used for what is probably the largest glue dryer in the world. It involves the use of three steel plate fans, 170 inches tall, having inlets 79 inches in diameter, outlets 63½ x 70 inches wide. The wheels inside the fan casings are 120 inches diameter by 66½ inches wide at periphery. Each one of these fans is driven by a 12 x 14 horizontal self-contained center-crank engine of the Buffalo Forge Company's make. Each fan will deliver at its outlet 150,000 cubic feet of air per minute at 1 ounce pressure. Each fan is to be supplied with a heater of appropriate size. The combined capacity of these fans is 450,000 cubic feet of air per minute. The outfit will be installed in the works of Delaney & Co., Philadelphia, under the specifications of Francis Bros. & Jellett, of Philadelphia.



THE BLAST SYSTEM OF HEATING WITHOUT DISTRIBUTING PIPES.

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It is announced that the Chinese Yamen has awarded to the Baldwin Locomotive Works, of Philadelphia, the contract to build eight locomotives for the Imperial Railway.

American Machinist.

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Space in advertising pages only is for sale.

We invite correspondence on subjects pertaining to machinery.

Name and address must always be given, though not necessarily published.

Communications for or relating to the reading columns should be addressed to the Editor. All business communications should be addressed to the Company.

Subscribers can have their mailing address changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrapper denotes week with which subscription expires.

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Foreign Trade Requires the Best Goods.

In conversation with a representative of one of our manufacturers of specialties in machine tools for manufacturing operations, who has enjoyed a large trade with European countries for some years past, and who prides himself especially upon the advanced character of his product, the statement was made that some of his best and most advanced work had been made for European customers, and had met with a better reception in Europe than here.

At first sight this condition of things seems entirely anomalous, but the explanation of it is simple. Making a specialty of a few lines of goods, as he does, this manufacturer naturally claims to know more about the possibilities of his machines than customers as a rule can. Nevertheless, these customers, as is usual with the users of machines, think themselves well informed, and when negotiating for machines they insist upon having their own ideas worked into the design and otherwise put limits upon the maker's freedom in designing. In the case of foreign customers, the machines are sold more largely on the reputation of the builder, and the two parties to the trade being separated in time and space, the tendency is far more to order a machine for a given purpose, and then to allow the designer free scope in working out the means for producing the results sought. In other words, in the case of domestic trade, the designer is restricted by reason of the purchaser being at his elbow; whereas the foreign customer, being at a distance, has less to say regarding the plan and details of the machine being bought. It is needless to say that a thoroughly competent builder can produce better results when unrestricted, than when tied down to restrictions and ideas of which he does not approve.

In one sense these are conditions under which extremes meet. We have all heard of unscrupulous dealers who, when filling an order from a distant customer, take advantage of the fact that his distance renders him in a measure without recourse, and supply him with any inferior goods that can be made the basis of a bill. In a case like the present, where the manufacturer has a personal pride in his product, combined with ability and desire to do advanced work, the results are quite the opposite.

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Credit and Pay for Shop Inventions and Improvements.

"At a manufactory in Baden for agricultural machinery the practice has been adopted that when any improvements or any labor-saving machines are introduced, the men's wages are not regulated so as only to leave them the same pay as before, but as a rule about half the profits arising out of the improvements are given to the men. This arrangement has proved very satisfactory, inasmuch as it induces the men to do their utmost and to tax their own ingenuity and intellect, to the joint advantage of themselves and their employers. In addition to this, the new system has made it possible to reduce the number of men by as much as 20 per cent."

The above we clip from "Engineering." It contains an important lesson which some men have learned, but which most of us utterly fail to appreciate.

If you talk with the average shop manager about doing such a thing, he says: "That is all right in theory, but it won't work. My competitors do not divide with their employés the savings effected by improvements in machinery and processes made in the works, and I pay a man a good salary for studying such matters. If I am to remain in business I must take advantage of all improvements as they are made in order to meet competition in prices. Otherwise my competitors who do this will have an advantage which will sooner or later prove fatal to me."

This seems perfectly logical, but, like much other current reasoning on economic subjects, is superficial and entirely ignores important modifying considerations.

It has been proven over and over again that no one man can see all the chances for improvements about an industrial establishment, and make the improvements as opportunity offers. No matter how able a superintendent or a foreman may be as an inventor of improved devices and methods, it is almost always true that the men who do the work can suggest improvements pertaining to their own department of it, which improvements would not be thought of by anyone else.

Of two shops, one managed by a man, himself skillful and inventive, but resentful or jealous of suggestions from employés; the other by a man not so skillful or inventive, but with equal executive ability, and with that kind of tact that calls out the hearty co-operation of employés and makes them feel that good suggestions will be appreciated, acted upon and acknowledged; we would much rather pin our faith to the success of the last-named establishment. It will, other things being equal, have the best appliances for doing work; these appliances will be handled by men interested in their success; the best men—the men most capable of making good suggestions—will be attracted to that shop; they will get the highest wages, but will turn out the lowest-cost work, and the best work.

In some shops the men suggest nothing; they simply do what they receive orders to do, and do it in the specified or usual manner. If you talk with the men who work in such a shop they will usually tell you that all the satisfaction or reward they get for improvements or suggestions is to hear the superintendent or the foreman claim the credit for them when showing the proprietor or a director about the shop.

The men in such a shop cannot be expected to take an interest in it; it would be contrary to human nature. Not only will they decline to make improvements of their own, but they will also give only a perfunctory service in the use of "the boss's" improvements, and will usually be a little better pleased to see them fail than succeed.

Sometimes the narrow-mindedness of a foreman stands in the way of enlightenment on these lines. Being narrow-minded and of very ordinary or perhaps no ability, he is all the time fearful that some of his men, by showing greater ability, will get ahead of and displace him; overlooking the fact that this very narrow-mindedness and jealously is the most effective known method of repelling good men, arousing their antagonism, and making the shop management a failure.

We know of one large establishment where this difficulty is avoided by having locked boxes with slit openings, into which the employés are invited to drop written and sketched suggestions. These are taken by the proprietor, and, when necessary, handed to various heads of departments for reports upon them. The employé is protected by a dated copy of his suggestion, which he can keep, and in case of a decision adverse to his proposed improvement, can, if he so elects, be heard in advocacy of it; while if it is approved,

its origin is a matter of record, and its originator is duly credited and rewarded.

We have many establishments here in which the fact is well understood that an important part of successful shop management is to recognize that there is such a thing as human nature, and that it is much better and easier to go "with the grain" in these matters than against it; but, on the other hand, we have others where there seems not to be the faintest glimmer of light on this important matter.

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The "Texas."

Again our battle-ship "Texas" has distinguished herself, this time by sinking in a dock at the Brooklyn Navy Yard, and sinking so quickly, in spite of so-called water-tight doors, and pumps, as to demonstrate that if the accident had occurred at sea the ship would have been lost, and probably most of her crew with her.

At this writing little is definitely known about the cause of the accident, further than that something gave way and allowed water to pour through an injection pipe, in a 13-inch stream, into the engine compartment, and that the so-called watertight bulkheads did not prevent this water from flooding other compartments and quickly sinking the ship.

We do not know that the origin of the "Texas" has anything to do with the matter, nor that a similar accident might not occur in the case of any other of our naval vessels; but it is interesting to note, nevertheless, that the "Texas" is really of a somewhat hodge-podge design—originally purchased in England at the instigation of "the line," and then "modified" and "improved" here. Perhaps we shall know all about the accident and its causes when the "Court of Inquiry" makes its report: and then, again, perhaps we won't.

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The Engineers' Club of New York will soon be prepared to entertain its members and friends in much better style than heretofore, it having acquired a lease of a house at 374 Fifth avenue, between Thirty-fifth and Thirty-sixth streets. It is expected that the club will spend about $20,000 in improvements on the property.

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Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(195) C. M., Brooklyn, N. Y., writes: I am using an 800-pound drop, dropping it about 14 inches, with no foundation of any account under it, the ground being solid. Have no trouble with hammer, but have had some complaints about the jar and noise, principally the noise. A foundation of concrete and timber on end will, I presume, absorb some of the jar (am I right?), but will it lessen the noise? A.—We think you are right regarding the absorption of jar, but do not think the noise will be lessened; in fact, it may be increased, in our opinion.

(196) A. B. writes: I saw the following question and answer in the "S—— A——": "All things being equal in both cases (that is, speed, load propelled and distance traveled), would the strain on the bicycle chains differ if one bicycle is geared at 70 and one at 80 inches? Would there be any difference in the strain on the chain if the front and the hind gears are transposed, other conditions being equal? A.—For equal work, as you state, the strain on the chain increases with the increase in the gear; 80 gear exerts a harder pull on the chain than 70 gear. By transposing the gear, the strain would be less on the chain by the difference in the relations of the sprockets." Is that answer right? A.—No. Whether a higher gear causes more stress upon a chain or not depends upon how the higher gear is obtained. If it is done by a smaller sprocket on the rear wheel, then the stress will be proportionately increased with the same load and speed, but practically it will remain the same, because the rider will in either case exert at times his full strength and impose the same stress upon chain so long as length of cranks and size of large sprocket remain the same. If higher gear is obtained by enlarging the crank sprocket, then with same load and speeds the stress on chain will not be altered, but the maximum stress that can be put onto the chain by a given rider will be reduced unless the cranks are lengthened to correspond. It is not true that 80 gear exerts a harder pull on the chain than 70 gear. With a given load going up a given grade at a given speed, that chain will be strained most that moves slowest, or, in other words, runs over the smallest rear sprocket, regardless of the gear of the machine. With a given pressure upon the peda's, and equal length of cranks, that chain will be strained least that runs over the largest crank sprocket, regardless of the gear of the machine.

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Business Specials.

Transient Advertisements 40 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear wheels, gear cutting. Grant; see page 14.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Engine Castings ⅛ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

Presses and dies for bar and sheet metal work. Ferracute Machine Company, Bridgeton, N. J.

Just Issued—Catalog No. 8. Mailed free. Clayton Air Compressor Works, 28 Cortlandt st., New York.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Patent Soliciting of High Class.—D. Walter Brown, Counsel in Patent Cases, 111 Broadway, New York. Send for "Brief History of Patent Legislation."

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The annual meeting of the Society of Naval Architects and Marine Engineers took place in this city last week, and was a well-attended and successful meeting, the engineer element being, however, not perhaps so prominent as in previous meetings, the marine architect being more prominent. Secretary of the Navy Herbert made an address at the dinner of the society, in which he stated that the American Navy was in excellent shape, and said that whenever it might be called upon it would be found to be on the alert, ready for its work, whatever and wherever that work might be. It seems a little ungracious for us to express doubts regarding this matter; but the fact is that there are those whose judgment in this matter we would much prefer to depend upon, who consider that there are alarming points of weakness in our navy, and that its personnel and organization are not such as to insure the highest efficiency. It is a well-known fact that there is a clique among the line officers which seeks to dominate everything and everybody connected with the navy. We believe it dominates Secretary Herbert himself, and it certainly undertakes to prevent, and does prevent, engineers from securing their plain and clear rights as citizens and as naval officers. If we know anything at all about the conditions necessary to naval efficiency, we would say that this is an element of decided weakness, notwithstanding what Secretary Herbert may think of it.

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Though it was at first reported that the Myers ballot machine worked entirely satisfactorily in Rochester, N. Y., at the recent Election, it is now stated that the City Council refuses to pay for the machines on the ground that they do not insure a secret ballot, but that the inspectors of election standing near the machines can tell by the clicking of the mechanism whether a man votes a straight or split ticket.

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It is reported that thirty manufacturers of bolts and nuts have recently held a meeting at Pittsburgh, Pa., and have effected an agreement under which the output and prices will be regulated. The combination thus formed is something similar to that which controls nail production.

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Commercial Review.

NEW YORK, SATURDAY EVENING, NOV. 14TH.

WHAT THE "BOOM" REALLY AMOUNTS TO.

The daily press have exerted themselves during the week following Election Day, in stirring up the market so as to bring anything in the line of renewed activity to the surface. The specific reports they have given may be taken as in the main correct. While it is not unlikely that the impression which these have tended to produce upon the public mind is an exaggerated one, there is little question that the tone of business is better than it was. Trade is likely to spread out gradually. A boom is an abnormal affair, and we may be better off without it.

In order to understand the case, it seems necessary to distinguish between the manufacturing and the selling ends of the various industrial establishments. The former has, in numerous instances, set its machinery in motion, or has increased its force or its hours of labor; which means that for the purpose of executing

orders that have been waiting, contingent upon the Election, or of accumulating stock, or upon general principles, it considers itself justified in so doing. The market moves more slowly. Some of the new activity may indeed be the result of actual new orders, but to get all the wheels of business in motion is a slow matter. The bearings of the market are in the sales-room, and some friction has here to be overcome before it begins to race.

IRON WORKING MACHINERY.

We have made the attempt to find out how the machine-tool interests centering in Liberty street feel about business, and upon the result some of the foregoing ideas are based. Machine-tool factories, however, have not been conspicuous among those reported as taking steps to increase their output, although some, we know, have done so. Perhaps this is because, owing to the export trade, they were busier, to start with, than some others, such as the iron mills; and it is said that their policy would not generally be to pile up stocks of tools before orders came in.

The actual business among machine-tool sellers in this city shows a little improvement. The majority of those with whom we have communicated are finding either more actual trade or more inquiry. At the same time, the tone assumed is generally a conservative one. A distinct betterment in surrounding business conditions is seen, and a recognition on the part of buyers that the time of forced aloofness from the market is at an end; but trade is advancing cautiously and without a rush.

The business which is actually apparent seems not to have polarized about any particular department of work but to include the ordinary run of tools, of which the largest are not the most in demand. From the reports which were published regarding increased work in railroad shops, we were inclined to think that these would be clamorous among the early buyers, but such has not been the case.

WOOD WORKING MACHINERY

shows here and there signs of activity, though some of its votaries are feeling a little blue. A number of the shops where it is manufactured have increased their operations. We happen to know that not in every case are the manufacturers as exuberant over business as this fact might imply, but that the average condition of the business is improved is probably safe to affirm.

MISCELLANEOUS REPORTS.

The various car-wheel works of John H. Bass had, up to November 12th, taken in more than $500,000 worth of orders since the Election.

The Clayton Air Compressor Works have closed a contract for twenty-five air compressors and twenty-five receivers of medium and small sizes, and during the first week of November they sold five air compressors. They think that the business indications in their line are favorable.

Resumptions and increases of output by mills, shops, etc., reported throughout the country, are being tabulated by some of the newspapers. The "Journal of Commerce," New York, which is doing so systematically, has accumulated, up to this morning's issue, the names of nearly 300 mills resuming, 100 of them being engaged in iron and steel work, and 7 machinery; and 217 which have increased force or output, 77 of them being iron and steel, and 19 machinery

The electric companies which have extended their work include the General Electric, Westinghouse and Walker.

SEPTEMBER MACHINERY EXPORTS.

The "Monthly Summary of Finance and Commerce," for September, issued by the United States Treasury Department, shows the following: Exports of domestic machinery—sewing machines, engines, boilers, locomotives, etc., included—for the month of September, 1896, amounted to $2,357,537, as compared with $1,381,745 for September, 1895. The report for August, 1896, showed $2,208,165. For this year up to, and including September, the amount is $18,097,908, against $12,174,557 for the corresponding portion of last year. (In comparing the figures, it is to be borne in mind that since July 1, 1896, have been included printing presses and typewriters; which, together for September, 1896, amounted to $158,784.)

THE IRON MARKET,

though more conspicuous on account of the many resumptions by mills and furnaces than of an actual increase in sales, is reported by local authorities to show a fair amount of business, with an improvement since the Election.

Quotations.

NEW YORK, Monday, November 16th.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$12 50 @ $13 00
No. 2 foundry, Northern	11 50 @ 12 00
No. 2 plain, Northern	11 25 @ 11 50
Gray Forge	11 00 @ 11 50
No. 1 foundry, Southern	12 25 @ 12 50
No. 2 foundry, Southern	11 50 @ 11 75
No. 3 foundry, Southern	11 25 @ 11 50
No. 1 soft, Southern	11 75 @ 12 00
No. 2 soft, Southern	11 25 @ 11 50
Foundry forge, or No. 4 Southern	10 75 @ 11 00

Bar Iron—Base—Mill price, in carloads, on dock; common, 1.15 @ 1.20c.; refined, 1.25 @ 1.50c. Store prices: common, 1.40 @ 1.50c.; refined, 1.50 @ 1.80c.

Tool Steel—Ordinary sizes, standard quality, 5 @ 7c.; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—The "combine" meets to-day and an advance from the old prices of 1.65 @ 1.70c. for ordinary brands from store is expected.

Cold Rolled Steel Shafting—Base size in carloads, about 2½c.; 2¾c. for smaller quantities from store.

Copper—Carload lots, Lake Superior ingot, 11⅜; electrolytic, 11¼c.; casting copper, 11⅛c.

Pig Tin—For 5 and 10-ton lots, 13.10 @ 13.20c., f.o.b.

Pig Lead—In carload lots, 2.95c., f. o. b.

Spelter—In carload lots, New York delivery, 4.20c., f. o. b.

Antimony—Cookson's, 7¼ @ 7½c.; Hallett's, 6⅝c.

Lard Oil—Prime city, present make, commercial quality, in carload lots, 44 @ 45c.

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Manufactures.

Des Moines, Ia., will erect a large municipal lighting plant.

Brewster Bros. are about to erect a new steam saw mill at Norwood.

Scott Bros. Electric Co., Detroit, Mich., have decided to increase their power plant.

Waverly, Minn., will construct a modern water system and an electrical lighting plant.

The Paxton Rolling Mills, Harrisburg, Pa., will place a flanging machine, steam tanks, etc.

The Automatic Electric Pump Company is to erect a factory at East Braintree, Mass., at once.

The United States Carriage Company, Columbus, O., will rebuild the factory gutted by fire recently.

The Caseville Electric Light Co., of Caseville, Mich., have decided to increase their power plant.

The York Haven Paper Co., York Haven, Pa., will install new machinery in their chamois factory.

The East Lebanon Iron Co., Lebanon, Pa., will at once erect a new mill, and install engines, shears, etc.

The Globe Brass Works, Detroit, Mich., capital

(Continued on page 37.)

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Help Wanted.

Situation and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

TO SUBSCRIBERS

whose names appear on our subscription list, this paper will give two free insertions under this heading to those in want of positions. The advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

Compt. draftsman wants pos. E. P., AM. MACH.

Help Wanted—Good pay for leisure hours. Geo. W. Lord, Philadelphia, Pa.

Successful man wants position as superintendent or foreman. BOX 147, AMERICAN MACHINIST.

Wanted—A first-class exp'nced boring mill hand. Apply to The Royal Electric Co., Montreal, P. Q.

Wanted—Position by a foreman boiler maker; a hustler. Address BOX 155, AMERICAN MACHINIST.

Draftsman, 5 yrs.' exp., tech. grad., wants pos. 3 or 4 days each week. BOX 171, AMER. MACHINIST.

Experienced mechanical draftsman wants position; best references. BOX 169, AMER. MACHINIST.

Competent draftsman wants position; 10 years' experience; references. BOX 170, AM. MACHINIST.

A first-class pattern maker wants position; a young man with experience on machine tools, etc. BOX 154, AMERICAN MACHINIST.

Wanted—Position by competent pattern maker who can handle men and get out work to advantage. BOX 166, AMERICAN MACHINIST.

Wanted—First-class machine tool salesman for Chicago house; good opening for right man. Address BOX 163, AMERICAN MACHINIST.

Practical and successful designer, A 1 draftsman, 20 years' varied experience, designer of high grade engines, desires position. BOX 263, Ridgway, Pa.

A technical graduate with 10 years' shop and drawingroom experience, would like a pos. as ass't sup't with growing concern. BOX 165, AM. MACH.

Wanted—A first-class machinist (tool hand) and capable of taking charge of general work when necessary; must be married and have steady habits. BOX 157, AMERICAN MACHINIST.

A foundry foreman with considerable experience on marine, stationary and pumping engines, a good hustler, and can furnish references, now open for engagement. BOX 161, AMERICAN MACHINIST.

Mechanical engineer wishes to change; qualified in managing help, 15 yrs.' exp. as machinist and designing of marine & stationary engs., power plants, general and special machy. BOX 159, AM. MACH.

A young man, energetic and capable, desires position as tool maker or foreman, having had charge of help in cycle factory; similiar position preferred; steady and sober. BOX 141, AMERICAN MACHINIST.

A practical and exp'd eng'r, mach'st and draftsman, familiar with mach. shop practice, mill & fact. const., etc., desires engagement with firm requiring such a man; moderate salary. BOX 125, AM. MACH.

Superintendent, thoroughly experienced on engine, boiler, mining and general mach'y and manufacturing work, under 40, strictly temperate, would like to make a change January 1. BOX 164, AM. MACH.

Wanted—By an up-to-date machinist who has had 20 years' experience, situation as foreman or assistant superintendent; has had experience in handling men with good results; best of reference BOX 152, AMERICAN MACHINIST.